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ASD-TDR-63-182

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FLAME SPEED DATA REDUCTION AND CORRELATION USING A DIGITAL COMPUTER

TECHNICAL DOCUMENTARY REPORT ASD-TDR-63-182 February 1963

Flight Accessories Laboratory
Aeronautical Systems Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

Project No. 6075 Task No. 607505



(Prepared under Contract No. AF 33(657)-7617 by Monsanto Research Corporation, Dayton, Ohio; G. H. Ringrose, D. R. Miller, A. C. Pauls and G. B. Skinner, authors)

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FOREWORD

This report describes work performed under Contracts AF 33(616)-7757 and AF 33(657)-7617, "A Research Program for Understanding the Mechanisms of Flame Inhibition," and AF 33(616)-7458, "Fire-Resistant High Temperature Hydraulic Fluids." The former contract was initiated under Project No. 6075, "Flight Vehicle Hazard Protection," Task No. 607505, "A Research Program for Understanding the Mechanisms of Flame Inhibition." The latter was initiated under Project No. 7340, "Non-Metallic and Composite Materials," Task No. 734008, "Power Transmission, Heat Transfer Fluids, and Other Forms of Energy Transfer Fluids."

The contracts were performed at the Dayton Laboratory of Monsanto Research Corporation. The first two contracts were sponsored by the Flight Accessories Laboratory, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio with Mr. Benito P. Botteri serving as project engineer. The third contract was sponsored by the Directorate of Materials Processes, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio with Mr. Harold Adams as project engineer.

For Monsanto, the computer program was written by Dr. G. H. Ringrose of Monsanto Research Corporation and Dr. D. R. Miller and Dr. A. C. Pauls of Monsanto Chemical Company. Dr. G. B. Skinner served as project leader.

The authors are indebted to Dr. W. C. Hammann of Monsanto Chemical Company for the hand calculations that led to the adoption of the general mathematical approach. This contribution and the many helpful suggestions made by numerous people are acknowledged with gratitude. Particular assistance was given by Mr. D. J. Kaufman, also of Monsanto Chemical Company, who was instrumental in trouble shooting and expediting the machine solutions.

The routines were originally programmed and run on the IBM 704 computer in the Research and Engineering Division of Monsanto Chemical Company, St. Louis. Later the programs were adapted for solution by an IBM 7090, at the Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

ABSTRACT

Two digital computer routines were developed to process flame speed data resulting from the burning of compounds in air and oxygen, and to correlate particular structural configuration with flame speed.

In both routines a high degree of flexibility has been incorporated to assure efficient utilization under several forseeable circumstances.

The first routine, FSC, processes the raw experimental data to obtain flame speeds, equivalence ratios, and the equivalence ratio at the maximum flame speed. This information is stored on a master magnetic tape for subsequent calculations.

The second routine, FSR, permits selection of specific data groups from the master tape for analysis. A linear model was chosen for the correlation.

This technical documentary report has been reviewed and is approved.

WILLIAM C. SAVAGE Chief, Environmental Branch Flight Accessories Laboratory

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FLAME SPEED DATA REDUCTION AND CORRELATION USING A DIGITAL COMPUTER

I. INTRODUCTION

Two Air Force-supported programs at this laboratory concern the relative rates of combustion of a number of chemical compounds. One program \sqrt{AF} 33(616)-74587 deals with the synthesis of potential high temperature hydraulic fluids and the other \sqrt{AF} 33(616)-76177 with increasing our understanding of the mechanisms of flame inhibition, the ultimate objective being the development of agents for extinguishing propellant fires.

Searches for effective fire-resistant fluids or propellant fire extinguishants would be systematized and expedited if a general method for characterizing, measuring, and predicting combustibility were at hand. Unfortunately, most flammability tests and specifications in use are so application-oriented or otherwise restricted as to be of only limited value for general use. A measure of the intrinsic ability of a material to support or inhibit combustion, as free as possible from influences peculiar to the testing procedure, is the first requisite. Given such a measure, there is then the possibility of relating combustibility to the molecular structures of materials tested and of predicting therefrom the combustibility of untested candidates.

This report describes computation routines designed to support the above approach. Flame speed - a state property of a combustible gas mixture - is the intrinsic measure of combustibility selected for use in characterization, correlation, and prediction. Earlier work, although limited to pure hydrocarbons burned in air, tends to confirm the approach adopted here.

The routines are programmed in the FORTRAN II language for IBM 7090 solution.

Manuscript released by authors February 1963 for publication as an ASD Technical Documentary Report.

II. THEORETICAL ASPECTS

Theoretical flame speed is commonly defined as the subsonic rate of perpendicular propagation of an infinite plane flame front through the quiescent combustible gas. External forces (for example, gravitational or magnetic fields) are presumed absent or insignificant, and the flame-induced flow is assumed to be laminar and one-dimensional.

When defined in this idealized manner, flame speed is a function only of the initial temperature, pressure, and composition of the combustible gas. It is thus an intensive state property of the gas, just as are density, enthalpy, viscosity, refractive index, and the like. Moreover, flame speed is a transport property dependent upon the rates of energy, momentum, mass, and chemical exchange accompanying combustion.

Prediction of flame speed from gas temperature, pressure, and composition is a long-standing goal of combustion research. A reasonably general and accurate method would be extremely useful in solving a range of practical and theoretical problems. Combustor and propulsion system design may be cited, in addition to the materials search problems underwriting the work of this report.

In principle, flame speeds can be predicted theoretically. Simultaneous solution of the differential equations of change is possible when all important physical-chemical properties (e.g., heats of reaction, reaction rate constants, density, diffusivities, emissivity, etc.) are known. Unfortunately, many of these properties are not yet known. Combustion reaction mechanisms are normally quite complex and are consequently poorly understood. Much remains to be done, even in the identification of intermediate chemical species.

While theory is of little practical utility, empirical correlations offer considerable promise. Hibbard and Pinkel (Ref. 1) achieved a good correlation of maximum flame speed of 37 hydrocarbons (mixed with air) versus the concentrations of the various C-H bond types present. The relation used was of the form

$$u_{\max} = \mathcal{E}_{j}b_{j}(c_{j})_{\max}$$
 (1)

The concentration $(c_j)_{max}$ of the j type bond is determined at the fuel-to-oxidizer ratio which yields the maximum flame velocity u_{max} and the corresponding influence coefficient for this bond is designated b_j . The average per cent deviation

between the measured and predicted maximum flame speeds was about 2% for the 37 hydrocarbons correlated.

The approach of Hibbard and Pinkel was extended by Hammann and Blake (Ref. 2) in calculation of flame speed coefficients of the various bond types in fuels containing oxygen, nitrogen, sulphur, boron, and silicon in addition to carbon and hydrogen. Their correlations were based upon data obtained experimentally by burning 142 model compounds and upon data reported by Gibbs and Calcote (Ref. 3). Several modifications of the correlation model, Equation 1, were tested and Equation 1A was found to provide the most acceptable correlation.

$$\frac{u_{\text{max}}}{(c_f)_{\text{max}}} = \angle j \ b_j \ n_j \tag{1A}$$

The number of j-type contributors occurring in each molecule of fuel is designated \mathbf{n}_{j} .

While the agreement between the predicted and measured flame speeds was not as good as for hydrocarbons alone, the results convincingly supported the general utility of the linear correlation technique. The computer routines described in this report were used by Hammann and Blake.

DEFINITIONS

The following terms are used frequently throughout the report:

Contributor

A countable structural feature of a fuel molecule (e.g., each hydrogen bonded to a primary carbon in H H ethane, HC-CH, could be classed as a contributor).

H H

Contributor number j An identifying code number which is assigned to each defined contributor (e.g., the primary-H contributor was assigned the code number 37).

Contributor count n_j (or n_{ij}) The number of j-type contributors contained in a molecule of fuel (or in a molecule of the 1th fuel)(e.g., the contributor count of the contributor primary-H in the fuel ethane would be 6).

Fuel A material that forms a combustible mixture when mixed with an oxidant. Included are impurities, additives, and all compounds not included in the gaseous oxidant. For totalling the contributor count for mixed or composite fuels,

it is assumed that the over-all fuel has additive properties of the compounds present. For example, if z_1 is the mole fraction of compound i in the fuel, and $n_{1,j}$ is the count for contributor j, then

 $n_j = z_1 n_{1j} + z_2 n_{2j} + \dots$

Oxidant The portion of the combustible mixture which includes the oxygen and inert gases but excludes the fuel.

Equivalence Ratio The actual fuel-to-oxygen ratio divided by the fuel-to-oxygen ratio stoichiometrically required for complete combustion of the fuel oxidizer. This is a measure of the richness or leanness of the flame.

Standard Error Synonymous with the statistical quantity "standard deviation."

<u>Data Group</u> A unit of data pertaining to a single fuel-oxidant combination burned at various equivalence ratios but otherwise under identical conditions. The components of a data group in the order in which they are stored by the computer on master tape δ are:

- (a) Serial Number Assigned sequentially by the computer in order of tape location.
- (b) Fuel Name Alphabetic and/or numeric representation of the fuel, e.g., (n-Pentene-2). A maximum of 12 characters (including blanks) is permitted.
- (c) Fuel Numbers Code numbers which are used to classify the types of fuel.
 - (1) Fuel Class Number General fuel type (e.g., Ol-organic aliphatic; O2-organic aromatic, O0-inorganic).
 - (2) Fuel Group Number Denotes subclassification of fuel type (e.g., O6-saturated cyclic compound).
 - (3) Fuel Member Number An arbitrary code number, used to indicate sequence of experimental analysis of a particular group.

Thus for the fuel cyclopropane the fuel number is 010601.

(d) Data Source Number Designates the source of the data (e.g., Ol-literature-, O2-experimental).

- (e) Experimental Conditions Number A code to distinguish data taken under different experimental conditions, such as temperature, pressure, per cent oxygen in oxidant, etc.
- (f) Flame speed at unity equivalence ratio, ustoc (cm/sec).
- (g) Maximum flame speed, u_{max} (cm/sec).
- (h) Fuel concentration at unity equivalence ratio, (c_f)_{stoc} (molecules/cc).
- (i) Fuel concentration at the conditions of maximum flame speed $(c_f)_{max}$ (molecules/cc).
- (j) Equivalence ratio at the maximum flame speed, \emptyset_{\max}
- (k) Number of different defined (i.e., coded) contributors in the fuel molecule.
- (1) List of the contributor code numbers with their respective counts for the fuel considered.

III. DESCRIPTIVE OUTLINE OF THE CALCULATIONS

An analysis of the computations required to reduce the experimental data and perform the regression analyses led to the separation of the problem into two sections. The first section processes the raw experimental data and calculates the flame speeds, concentrations, and equivalence ratios. These quantities are then stored on a master reel of magnetic tape. The second section, namely, the flame speed regression section, uses this reel of magnetic tape as its input data. From these data, the regression coefficients of the flame speeds and other dependent variables are determined.

Corresponding to each of these sections is a Fortran routine that is described in detail in a later section. A general discussion of these routines follows.

DATA REDUCTION (Routine FSC)

The data reduction routine calculates the flame speed and related quantities from the raw data, tests these quantities for inconsistencies, and prepares or corrects the master reel of magnetic tape with acceptable data.

Flame Speed The calculations are based upon the conical (Bunsen) burner method for flame speed determination. Measured flows of the several components of the mixture are passed in laminar flow through a burner tube at a controlled temperature and pressure. A roughly conical flame front is stabilized at the mouth of the tube.

The large density gradient in the gas stream at the flame front permits the use of schlieren photographic techniques to record the flame profile. It is assumed that the flame is symmetrical about its vertical axis. Figure 1 is schlieren photograph of a typical flame cone.

The flame speed is determined by dividing the total volumetric gas flow rate by the area of the flame front. Since the flame cone photographed is seldom a "right circular cone," its surface area must be determined from measurements at several intermediate points. To do so, the diameter is measured at several heights of the cone as illustrated in Figure 2. The surface area between any two of these diameter measurements is assumed to be that of a frustrum of a right circular cone. The sum of the surface areas of these frustra gives a fairly accurate value of the true flame front area. Actually, the local flame speed is slightly above the average at the cone tip

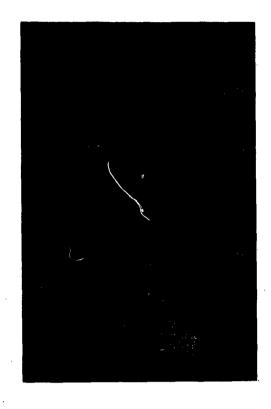


Fig. 1 Schlieren Photograph of a Flame Cone

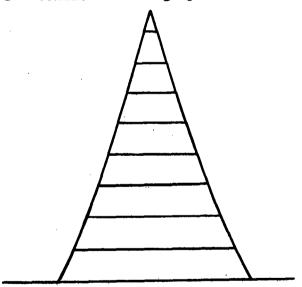


Fig. 2 Diagram of Flame Cone Profile

and slightly below the average at the base. Therefore, the calculated flame speed must be considered an average value only. Evidence has shown that there is a slight dependence of flame speed on the total volumetric flow rate of the gases, the burner part geometry, and the burner part temperature. Slight influences are also made by the method used to define the cone area (i.e., schlieren shadow, or radiant photography). However, by standardizing on one of the techniques, this variable can be eliminated.

 $\frac{\text{Valid Data Tests}}{\text{obtained, it is necessary to determine the conditions}} \text{ Once a series of flame speeds has been obtained, it is necessary to determine the conditions for maximum flame speed (since the correlations proposed are based on conditions at the maximum flame speed). This is accomplished by fitting an empirical curve of flame speed vs. equivalence ratio (u vs. <math>\emptyset$) to the data and solving the equation for the maximum. The flame speed at stoichiometric conditions (\emptyset = 1) is also determined.

If a maximum flame speed lies within the data range the data are acceptable for further tests. If no maximum or a minimum is found within the data range, the data are not acceptable.

Storage on Magnetic Tape Data groups termed acceptable are stored on a master reel of magnetic tape for use by the regression routine.

Options The computational routine contains several options depending upon the form of the input data. These options permit sections of the computational procedure to be omitted. For example, a set of flame speed vs. equivalence ratio data available from previous calculations could be entered directly into the sequence, and the original raw data calculations would be by-passed. These options are detailed in Section VI.

FLAME SPEED REGRESSION (Routine FSC)

A multiple linear regression model similar to that used by Hibbard and Pinkel (Ref. 1)(but including a constant term) was selected:

$$y = b_0 + \mathbf{Z}_j b_j n_j \tag{2}$$

Independent Variables In equation (2) the independent variables were chosen to be the contributor counts rather than the contributor concentration. This simplifies the prediction and data handling, and adds flexibility by making the "independent" variables more independent. This is true because the

contributor concentrations depend upon the mixture temperature, pressure, equivalence ratio, and oxidant composition, as well as upon fuel composition. A simple relation exists between the contributor counts and concentration, as shown in Equation 3:

$$c_j = n_j c_j$$
 molecules/cc (3)

where $c_{\mathbf{f}}$ is the concentration of fuel in the combustible mixture. Multiplying Equation 2 by c_f gives the equivalent of the Hibbard-Pinkel model ($b_0 = 0$).

Dependent Variables For the reasons mentioned above, the dependent variable y would be set equal to $u_{max}/(c_f)_{max}$ when the coefficients comparable to those published by Hibbard and Pinkel are wanted. However, this is not the only dependent variable of possible interest. In predictions of maximum flame speed, for example, it is necessary to predict fuel concentration (or fuel-oxidant ratio, or equivalence ratio) at maximum flame speed. This is most readily done by correlating fuel concentration (etc.) at maximum flame speed against contributor counts. Correlations at stoichiometric fuel-oxidant ratio may be equally interesting. To emphasize that such other dependent variables can be handled with equal facility, the indefinite dependent variable y is used.

With the emphasis so far given to fuel Coefficients composition, it is appropriate to recall that calculated bis are not constants. Values will depend on several or all of the following (depending on the definition of y):

- initial mixture temperature
- initial mixture pressure
- some specification of fuel-oxidant ratio
 oxidant composition
- contributor definitions
- dependent variable definition

The above list includes the primary state properties. Since experimental flame speeds (distinguished from theoretical flame speeds) are always obtained under conditions differing from the ideal, values of b; will be related to:

- experimental conditions (oxidant composition, temperature, pressure, etc.
- source of data (laboratory, technique, journal reference, etc.

All listed factors should be considered when sets of coefficients are compared.

Block Regressions Obtaining a full set of coefficients is basically a stepwise trial-and-error process. The trial-and-error enters in the definition of contributors (i.e., independent variables). Since it is not known at the outset which structural features will give the best correlations, it is necessary to accommodate definition of new contributors as the analysis progresses. In addition, it is desirable and most efficient to calculate certain coefficients using only a particular class of fuels. C-H bond coefficients, for example, are most readily and accurately determined from flame speed data on hydrocarbons. If accurately determined, a coefficient should be applicable unchanged in later regressions.

The above considerations indicated that a "block regression" procedure (certain coefficients held constant) would be most advantageous. This procedure may be expressed mathematically by Equation 4:

$$y - \mathcal{E}_s b_s n_s = b_o + \mathcal{E}_u b_u n_u$$
 (4)

The $b_{\rm S}$ coefficients represent those whose values are known, and are termed the "prespecified coefficients." The $b_{\rm O}$ and $b_{\rm U}$ coefficients are those to be determined by the regression analysis. The constant term $b_{\rm O}$ may be either calculated or prespecified as zero.

Block Selection Criteria All of the data groups that are acceptable for regression analysis are stored on a single master reel of magnetic tape. Seven different accept-reject tests are available for selection of these data. The selecting criteria comprise (1) data group serial number, (2) fuel class number, (3) fuel class-group number, (4) fuel member number, (5) data source number, (6) experimental conditions number, and (7) fuel contributor content.

For flexibility, these tests may be ignored, or applied singly or in any combination. The tests are described in detail in the following section.

IV. MATHEMATICAL OUTLINE OF THE CALCULATIONS

FLAME SPEED DATA REDUCTION CALCULATIONS (Routine FSC)

The functions performed by Routine Functions Performed FSC may be classed in five groupings. The portions of the computer program used in each function are enclosed in parentheses.

(Subroutines EXPD 1 or EXPD 3) Function 1

Given: (a) Combustion mixture, temperature and pressure

Fuel stoichiometric oxygen demand

(b) Fuel stoichiometric oxygen demod (c) Mole fraction of O2 in oxidant (d) Molar volume of fuel (e) Volumetric flow rate of oxidant (f) Flame envelope dimensions

Calculate: (a) Volumetric flow rate of mixture (b) Area of flame envelope (c) Flame speed

Equivalence ratio

(a) Volumetric flow rate of the mixture, qm

$$w_{x} = q_{x}*/22,414 \qquad g-moles/sec \qquad (5)$$

$$w_f = q_f/v_f$$
 g-moles/sec (6)

 w_f and w_x are the molar flow rates of the fuel and oxidizer and q_f and q_x^* are the volumetric flow rates in cc/sec (the latter at S.T.P.). v_f is the molar volume of the fuel and must be based on the same fuel density as qf.

$$v_m = 62,366(t_m + 273.15)/P_m cc/g-mole$$
 (7)

where v_m is the molar volume of the mixture and t_m ($^{\rm O}\text{C})$ and P_{mv} (atm.) are the temperature and pressure of the mixture.

Therefore:
$$q_m = (w_x + w_f)v_m$$
 cc/sec (8)

(b) Area of flame envelope, A

The increment of surface area $~\Delta \, {\rm A_{1}}$ between any two heights ${\rm h_{1}}$ and ${\rm h_{1-1}}$ is given by

$$\triangle A_{1} = \sqrt{\frac{D_{1-1} + D_{1}}{2}} \sqrt{(h_{1} - h_{1-1})^{2} + \left(\frac{D_{1-1} - D_{1}}{2}\right)^{2}} cm^{2}$$
 (9)

where D_1 is the measured diameter at the upper height and D_{1-1} is that at the lower height. The total surface area of the flame is calculated by summing these increments over the whole height

$$A = \underbrace{\stackrel{n}{=}}_{i=1} \Delta A_i \qquad cm^2 \qquad (10)$$

(c) Flame speed, u

Once the total flame area has been determined, flame speed can be easily calculated:

$$u = q_m/A \tag{11}$$

(d) Equivalence ratio, Ø

From its definition as the actual fuel-to-oxygen ratio divided by the stoichiometric fuel-to-oxygen ratio, the equivalence ratio is calculated:

$$\emptyset = (w_f/w_o)/(w_f/w_{ost})$$
 (12)

where \mathbf{w}_{0} is the molar flow rate of oxygen used in the experiment and \mathbf{w}_{ost} is that rate required for complete reaction.

But
$$w_0 = w_x z_{0x}$$
 g-moles/sec (13)

and
$$w_{ost} = w_f r_{st}/2$$
 g-moles/sec (14)

where z is the mole fraction of oxygen in the oxidant and where r_{st} is the number of atoms of oxygen required to completely oxidize one molecule of fuel.

Therefore
$$\emptyset = w_f r_{st} / 2w_x z_{ox}$$
 (15)

Function 2 (Subroutine MAXM)

A series of experimental values of flame speed vs. equivalence ratio. (The flow rates are the only controllable variables.)

Calculate:

(a) Maximum flame speed(b) Flame speed at stoichiometric condi-

(c) Equivalence ratio at maximum flame speed

(a) Maximum flame speed, umax

Past work has shown that curves of u vs. Ø generally are concave from below with a maximum in the vicinity of $\emptyset=1$. Figure 3 is an example of such a curve.

Many of the curves are fairly symmetrical in the vicinity of the peak and are nearly parabolic in shape. Others are fairly asymmetrical and are better approximated by a higher order power series. To find the peak of a given series of measured values of u vs. Ø, the data are fitted with an equation of the form

$$u = \sum_{r=1}^{R} a_r g^{r-1} \qquad cm/sec \qquad (16)$$

The method of calculating the "a" coefficients depends upon the number of points available, N. If N=4, a perfect cubic fit (R = 4) is obtained by solution of the simultaneous equations

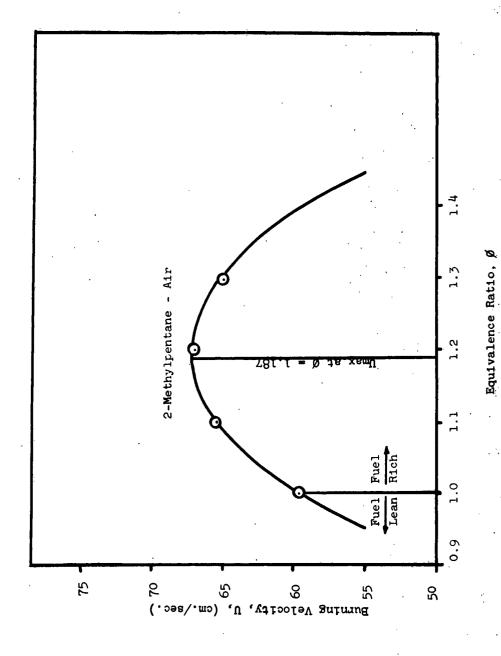
$$u_n = \frac{R}{\ell} a_r \, \phi_n^{r-1} \, n = 1, \dots R$$
 (17)

If N>4, a least square cubic fit (R=4) is obtained by the solution of the "normal regression equations."

$$\sum_{n=1}^{N} u_{n} \emptyset_{n}^{r-1} = \sum_{q=1}^{R} (a_{q} \sum_{n=1}^{N} \emptyset_{n}^{r+q-2}) r = 1 ...R (18)$$

The normal regression equations are the result of a mathematical treatment on the original polynomial, Equation 17. An explanation of the analysis may be found in statistics texts such as Hoel (Ref. 6).

Solution of these equations gives the set of "a" coefficients which minimize the residual sum of the squares:



Typical Curve Showing Burning Velocity, U, vs. Equivalence Ratio, Ø

$$Q = \sum_{n=1}^{N} (u_n - \widehat{u}_n)^2$$
 (19)

where $\hat{\mathbf{u}}_{n}$ represents a predicted value.

The standard deviation of u about \hat{u} is

$$S = \sqrt[+]{Q/(N-R)} \qquad cm/sec \qquad (20)$$

If the calculated standard deviation is greater than the one specified, the cubic fit is declared unsatisfactory and a parabolic fit using Equation 18 with r=3 is tried. If the standard deviation is still too high, the data set is ignored.

If only three points are available, a perfect parabolic fit, r=3, is obtained in the manner of Equation 17. Less than three points are not considered since they cannot define a curve with a maximum.

(b) Equivalence ratios

Double differentiation of Equation 17 with r=4 gives

$$\hat{\hat{u}} = a_z + 2a_3 \emptyset + 3a_4 \emptyset^2$$
 (21)

and
$$\hat{\vec{u}} = 2a_3 + 6a_4 \emptyset$$
 (22)

At the maximum

$$\dot{\hat{\mathbf{u}}}_{\text{max}} = 0 \tag{23}$$

and
$$u_{\text{max}}^{\prime\prime} < 0$$
 (24)

Solving Equations 21 - 24 yields

$$\emptyset_{\text{max}} = (a_3/3a_4)(1 - \sqrt{1-3a_2a_4/a_3^2})$$
 (25)

and
$$0 > \bar{+} 2a_3 1 - 3a_2 a_4 / a_3^2$$
 (26)

The inequality shows that the upper sign is to be used in Equation 26 when a_{γ} is positive, and vice versa.

For a real maximum to exist, three conditions must be fulfilled:

$$\mathbf{a}_{\perp} \neq \mathbf{0} \tag{27}$$

$$\mathbf{a}_3 \neq \mathbf{0} \tag{28}$$

$$1-3a_2a_4/a_3^2 > 0$$
 (real roots) (29)

at the minimum point $(\hat{u}_{\min}, \emptyset_{\min})$ of the cubic equation must also be determined:

$$\emptyset_{\min} = -(a_3/3a_4)(1 \mp \sqrt{1-3a_2a_4/a_3^2})$$
 (30)

The upper sign is understood to hold when a_3 is positive, and vice versa. This equivalence ratio must not lie within the data range.

When a satisfactory

$$\emptyset_{\text{max}} = -a_2/2a_3 \tag{31}$$

in which a, must be negative.

Function 3 (Executive routine)

- Given: (a) Combustion mixture temperature and
 - (b) Fuel stoichiometric oxygen demand (c) Mole fraction of O₂ in oxidant (d) Equivalence ratio at maximum flame speed
- (a) Fuel concentration at maximum flame speed(b) Fuel concentration at stoichiometric Calculate: conditions

(a) Fuel concentration at u_{max} , $(c_f)_{max}$ For a value of the equivalence ratio \emptyset , the fuel concentration is given by

$$c_{f} = \frac{(6.0238 \times 10^{23}) \text{pm}}{62,366(t_{m} + 273.15)(1 + r_{st}/20z_{ox})}$$
molecules cc
(32)

Therefore $(c_f)_{max} = c_f$ evaluated at $\emptyset = \emptyset_{max}$ (33)

(b) Fuel concentration at $\emptyset = 1$, $(c_f)_{stoc}$ Similarly,

$$(c_f)_{stoc} = c_f$$
 evaluated at $\emptyset = 1$ (34)

Function 4 (Executive Routine)

Results listed above Given: (a)

Composition, source, conditions and related input information

Stores in memory only acceptable data Action:

Function 5 (Subroutine Tape)

(a) Acceptable groups stored in memory

and on master tape 6

Changes to be made in the data already (b) on the master tape

Action: Edit the existing master tape data

(b) Add new data groups to the master tape

In all cases, the input data, intermediate values, and output values are printed out at each step.

Function Options Four options are provided to permit portions of the program to be by-passed. The options would be exercised if portions of the experimental data had been processed previously or if outside data were to be used.

Complete calculation (Functions 1 through 4) (Functions 2 through 4) (Function 4) 2. Partial calculation

No calculation

3. 4. (Function 5 - follows successful Tape writing execution of the other options)

FLAME SPEED REGRESSION CALCULATIONS (Routine FSR)

Routine FSR prepares the input Functions Performed data tape for the Esso Regression Analysis subroutine. Its operation may be considered in three stages:

Function 1

Given: (a) All data groups currently stored on master tape 6.

(b) A list of data group accept/reject tests

Action: Selects and stores up to 300 data groups passing the accept/reject tests

Seven different tests are available for accepting or rejecting data groups now recorded on the master tape for the regression analysis. These tests may be employed in any combination desired, including omission of any or all. A limit of 300 acceptable data groups has been imposed for each regression run. If more than 300 could pass the tests, only the first 300 doing so are accepted for regression.

- (a) Data group serial number test Those data groups whose serial numbers (machine assigned in order of tape position) are given in an input specification list are unacceptable.
- (b) Fuel class test Only those data groups whose fuel class numbers are specified in an input list are acceptable.
- (c) Fuel group test Only those data groups whose fuel class-group numbers are specified in an input list are acceptable.
- (d) Fuel member test Only those data groups whose fuel class-group-member numbers are not specified in an input list are acceptable.
- (e) Data source test Only those data groups whose source number corresponds to an input source number are acceptable.
- (f) Experimental conditions test Only those data groups whose experimental conditions number corresponds to an input conditions number are acceptable.
- (g) Contributor count tests Data groups may be acceptable or unacceptable depending on the presence or absence of given contributors in the fuel molecule. In addition, the counts of any specified contributors may be assumed zero whether they are zero or not on the master tape.

Function 2

Given: (a) All data groups selected as above(b) Dependent variable numerator and

denominator code numbers

A list of prespecified coefficients with their corresponding contributor numbers

Calculate:

Adjusted and scaled dependent variables for regression

(a) Dependent variable calculation The basic regression problem is to determine the bu and bo coefficients in the equation

$$y = b_o + \xi_u b_u n_u \tag{35}$$

such that the sum of the squares of the difference between the actual and predicted values is minimized. Routine FSR provides the option to define the dependent variable y provided the independent variables are still contributor counts. Thus, if regression of the maximum flame speed on contributor concentrations at maximum flame speed is desired, y would be defined

$$y = u_{max}/(c_f)_{max}$$
 (36)

The dependent variable y may be any quantity expressible as a simple ratio of any two of the following quantities:

Quantity	Identification Number
1.0	1
^u stoc	2
u _{max}	3
(cf)stoc	4
(c _f) _{max}	5
$m{arphi}_{ exttt{max}}$	6

(b) Dependent variable adjustment If it is desired to prespecify (and therefore not calculate) some of the b coefficients in a given problem, it is necessary to adjust

the dependent variable by subtracting the contributions associated with the prespecified coefficients. Equation 37 indicates the procedure

$$y'_{1} = y_{1} - \xi_{s}b_{s}n_{1s} \tag{37}$$

 $\underline{\text{(c)}}$ Dependent variable scaling To avoid exceeding the numerical limit of the computer (1038) during the regression calculations, all of the final dependent variables are scaled (i.e., multiplied by a constant factor)

$$Y_{\underline{i}} = y'_{\underline{i}} \cdot 10^{E} \tag{38}$$

so that the largest Y, in a given problem does not exceed 1000.

Function 3

Given:

(a) All data obtained above(b) Input lists of overriding regression control data (optional)

For each valid regression problem store on Action: tape 7:

Output page heading.

Regression control data

Independent variable values (contributor counts)

Adjusted and scaled dependent variable values

The regression analysis routine, a modification of SHARE E-R-MPR2, requires input data for the control of calculation and printing. One of the functions of routine FSR is to supply the needed data in the proper form. Although this is done automatically using internally stored values, input control data may be given if it is desired to override any of these values.

In all cases the important input data and intermediate and output values are printed for each function listed above.

V. THE COMPUTER PROGRAM

FLAME SPEED DATA REDUCTION (Routine FSC)

Routine FSC consists of an executive, or master control program and the eight subroutines listed below.

- 1. EXPD1
- 2. EXPD3
- 3. MAXM
- 4. TAPE
- 5. CROUT
- 6. INPUT
- 7. VDECOM
- 8. DECDCP

Section IV contained a brief outline of the functions of the executive routine and the first four subroutines listed above. Here, these shall be discussed in more detail.

Executive Routine
selection of five of the eight subroutines. The first data card in each group contains information regarding the option to be performed, the use of EXPD1 or EXPD3 and the use of MAXM. The executive routine reads this card and sequences the operations accordingly. Diagnostic code numbers are present in each of the subroutines and if any of these are exercised the executive routine will cause the printout of a diagnostic. If subroutine MAXM indicates that the data processed were satisfactory, the executive routine will store the pertinent values in memory prior to their addition to the master tape. Two small calculations, (cf)_{st} and (cf)_{max} are also made. It has been attempted to indicate each step in the actual program with "comment cards", and for convenience a nomenclature list precedes each routine. These can be found in Appendix A.

Subroutines EXPD1 and EXPD3 Both subroutines perform the same basic calculation of total cone area, flame speed, and equivalence ratio. However, the respective data outputs differ slightly. It was considered less confusing if each alternative had its own subroutine. Which subroutine to use is determined mainly by the intended use of the data after processing.

If the data to be processed are to be considered for addition to the master tape, subroutine EXPDI should be used. In this subroutine, one experimental run number pertains to the entire data group and the input and output are set up accordingly.

If a set of control data are run sequentially, subroutine EXPD3 should be used. Each calculation is listed sequentially in the output to avoid confusion of the output with that from EXPD1. Sample printouts from both subroutines may be found in Appendix A.

Subroutines MAXM and CROUT Subroutine MAXM analyzes the data to see if either a valid cubic maximum or a parabolic maximum occurs within the data range. Subroutine CROUT solves the equations generated for the regression coefficients. As the logic used in subroutine MAXM is more involved than in the others, a brief stepwise description is presented.

- 1. If the number of experiments (or points) per data group is 1 or 2, signal that the data are "bad" and return to the executive routine. If there are 3 points, go to step 6; otherwise go to step 2.
- 2. Calculate the cubic coefficients either from the cubic polynomial (4 points) or from the "normal regression equations" (more than 4 points), as indicated in Section IV. If the calculation is successful, go to step 3; if not, to step 6.
- 3. Check cubic maxima criteria (coefficients zero or imaginary square root). If all are satisfied go to step 4; if not, to step 6.
- 4. Calculate \emptyset_{\max} and \emptyset_{\min} . Check for \emptyset_{\max} inside data range and \emptyset_{\min} outside data range of \emptyset . If so, go to step 5; if not, to step 6.
- 5. Calculate u_{stoc} , u_{max} , \widehat{u}_n , absolute and per cent differences between u_n and \widehat{u}_n , and standard deviation S. If S is less than or equal to a specified value, signal the data "good" and return to the executive routine; if greater, signal the data "bad" and return to the executive routine.
- 6. Calculate the parabolic coefficients from the quadratic polynomial (3 point) or from the "normal regression equations" (more than 3 points). If the calculation succeeds, go to step 7; if not, to step 9.
- 7. Check for negative coefficient a_3 (curve concave downwards). If so, calculate \emptyset_{\max} and go to step 8; if not, to step 9.

- 8. Check for \emptyset_{max} inside \emptyset data range. If so, go to step 5; if not, to step 9.
- 9. Signal the data "bad" and return to the executive routine.

Subroutine TAPE This subroutine controls all operations that change the contents of the master tape. The first portion of the routine scans the tape and makes the alterations to the data groups that were specified on an input data card. The second section permits the alteration or addition of contributor code numbers and names. The third section adds to the master tape the new data groups that were either approved by MAXM or entered via option 3. The final section is used only for the initial makeup of the master tape. Once the tape contains some data the other portions of the program may be used without a sequencing diagnostic.

Subroutines INPUT, VDECOM, and DECDCP These subroutines facilitate preparation of the input data cards by permitting a variable width format. The complete card format is described in Section VI.

FLAME SPEED REGRESSION (Routine FSR)

Routine FSR prepares the input data for the E-R-MPR2 Esso Multiple Regression subroutine. It does not alter the input data (with the exception of scaling the dependent variable), but serves only for selecting the appropriate data for the regression analysis. In addition, control data are supplied for the Esso program.

Accept/Reject Tests Seven tests are provided for accepting or rejecting data groups. The first six tests are simple yes/no choices and were explained in Section IV. These tests are listed below.

- 1. Data group serial number test
- 2. Fuel class test
- 3. Fuel group test
- 4. Fuel member test
- 5. Data source test
- 6. Experimental conditions test

Test 7, the contributor count test, is more complicated and will be explained here in detail.

Data groups will be found acceptable or unacceptable depending upon the presence or absence of particular contributors in the fuel molecule. In addition, the counts of any contributor may be set equal to zero. The code numbers and test operation are listed below.

one test - The count of this contributor may be either zero or positive.

two test - The count of this contributor must be zero or the group will be rejected.

three test- The count of this contributor must be positive or the group will be rejected.

four to - Six tests are available to select data groups nine tests on the basis of a particular contributor content. The acceptance of a data group may be conditional upon it containing (+) and/or excluding (-) a certain number of a list of contributors. An example should clarify this.

Example

The data card types are given an alphabetic identification. The contributor count tests are specified on a "P" type card and the conditional tests on a "Q" type card.

(a) Sample P-type Card 1, 0, 15, 1, 16, 0, 27, 4, 29, 5, 32, 3, 33, 5, 34, 4, 37, 2, 40, 6, 61, 0.

Interpretation

Apply zero test (0) to contributors number 1-14, 16-26, 61 and up Apply one test (1) to contributor number 15 Apply two test (2) to contributors number 37-39 Apply three test (3) to contributor number 32

The above tests are specific; the following are conditional:

Apply four test (4) to contributors number 27, 28, 34-36 Apply five test (5) to contributors number 29-31, 33 Apply six test (6) to contributors number 40, 41

(b) Corresponding Q-type Card

+3, -2, +1

Interpretation

Four test; the data group must contain (+) at least 3 contributors from the list 27, 28, 34-36.

Five test; the data group must not contain (-) at least 2 contributors from the list 29-31, 33.

Six test; the data group must contain either contributor 40 or 41.

NOTE: Conditional tests 7 to 9 were not used in the example.

Dependent Variable Limitations Up to 10 different dependent variables may be regressed in a single computer run (problem numbers 1 to 10). All problems in the same run share a common list of regression control data and operate on the same set of selected data groups.

Regression Control Data The regression analysis subroutine, a modification of SHARE E-R-MPR2, requires several pieces of information for the control of calculation and printing. One function of routine FSR is to supply the needed data in the proper form. This is done automatically using internally stored values. Only when it is desired to override one or more of the internal values is it necessary to supply input control data. Internally stored values are given in the following list.

<u> Item</u>	Description	Built-in Value
Dec. 1	Tolerance F value for entering variable F value for removing variable Problem number Number of variables	0.001* 0.00002* 0.00001*
Int. 1 2 3 4 5	Problem number Number of variables Number of points (data groups) Weighting factors given Intermediate steps printed Raw sums of squares and cross products printed	calculated calculated calculated (no) 0 (yes)*
7 8 9	Averages to be printed Residual sums of products to be printed Partial correlation coefficients to be	1 (no)* 1 (no)* 1 (no)*
10 11	printed Predicted values (Y ₁ 's) to be printed Constant term (b _o) to be assumed non-zero	0 (yes)* 1 (no)*

Values marked with an asterisk may be overridden by input values.

VI. USE OF THE COMPUTER PROGRAMS

Both routines have been written in the standard FORTRAN II language compatible with most large-scale computing equipment. A maximum of four magnetic tape units are required in addition to any tape units used for input-output operations. The routines, as presented in Appendices A and B, are programmed to be compatible with the IBM 7090 Monitor system, with Tape 2 designated as the input and Tape 3 as the output.

Two additional routines have been included to avoid the storage of the master data tape over a period of time. Routine FSRDM will prepare a master data deck, or modify an existing data deck from information contained on the master data tape. Routine FSRTL will prepare a tape from the master data deck. These routines are presented in Appendix C.

INPUT DATA DECK PREPARATION

The programs accept the standard IBM type, 80-column punched cards. However, only columns 1 to 72 may contain information to be processed by the computer. It is recommended that columns 73-80 be used for some type of identification both for the users standpoint as well as for the computing center.

All decimal input data and most integer input data are processed via subroutines VDECOM and DECDCP before being used in the computation portion of the main routine. The use of these subroutines simplifies data card preparation to the extent that field widths may be neglected. It is only necessary to provide a blank space or a comma between entries on the data cards. One restriction is imposed though. No entry may end in column 72 on the data card.

FLAME SPEED DATA REDUCTION

The input data deck may consist of several sets of cards depending on the nature of the data and the option applicable. If only the calculated flame speed is of interest, an unlimited number of data sets may be entered. If, however, options 1, 2, or 3 are used for the purpose of adding data groups to the master tape, an option 4 must follow every 20 sets or less. This limitation is imposed because of the internal storage requirements of the program. Options 1, 2, or 3 may be run in any order.

To simplify the makeup of the data decks, each card fulfilling a specific purpose has been assigned an alphabetic code letter. Below are listed the data deck requirements for each of the options available. The actual makeup of the cards follows.

Option 1 Calculation of Flame Speeds from Raw Data

The first four card types set up the calculation sequence and define certain general conditions. The remaining cards contain the experimental measurements for each flame photograph. Thus, for a total of $\rm N_2$ photographs, the card order would be:

Card Order	Card Type
1	A
2	X
3	В
4	C
5 to $N_2 + 4$	D

Certain entries on the A card determine whether or not a full calculation or just the flame speeds are required. If the latter is the case, any number of these sets may be submitted, otherwise the maximum number before a tape writing sequence is 20. N_2 is limited to 10.

Option 2 Calculations for Given Equivalence Ratios and Flame Speeds

The first four card types are similar to those mentioned above. The last card contains the predetermined flame speeds and equivalence ratios.

Card Order	Card Type
1	A
2	A
3	B
4	C
5	E

Option 3 All Final Values Given

Only the information on the first three card types is required.

Card Order	Card Type
1	A
2	X
3	В

Option 4 Tape Writing and Editing

The first card type remains the same. The second card type contains information about the remaining two card types.

Card Order	Card Type
1	A
2	F
3	G
4	H

Card Content by Card Type All numerical input data for routine FSC are processed by subroutines VDECOM and DECDCP. In the listings below, all integer quantities are designated Int. and all floating point quantities (e.g.,002 or 2.E-3 or 2.-3) are designated Dec. The only restrictions on preparation of these cards are that column 72 must be blank and each entry must be separated by at least one blank or comma. Readin of alphanumeric input is accomplished with an "A" format and the card column designations below must be maintained.

A Card

	Entry	1 2 3		Int. Int. Int.	1000, card identification Run number (1 to 9999) 4, number of integer entries following
		4		Int.	Option number (1 to 4)
		4 5 6		Int.	EXPD, subroutine number (1 or 3) No. number of inhibitors present
				Int.	
		7		Int.	MAXM, subroutine switch (0-use, 1-bypass)
		8		Int.	1, number of decimal entries following
		9		Dec.	O., dummy entry
<u>x</u>	Card				
		_	Columns		
	Entry				0000, card identification
		2			O, dummy entry O, dummy entry
		Ι,	13-24		etic, fuel name
		234567	25-36	Alphabe	etic. date
		6	37-48	Alphabe	etic, date etic, inhibitor name
		7	49-60	Alphabe	etic, inhibitor name

A maximum of ten inhibitor names may be entered. These names must follow sequentially on the data cards and must occupy twelve columns per name. Columns 1 to 12 on each card, however, must contain the three integer entries listed above. Thus, if $N_{\rm O}$ were 4, the fuel name, data and three inhibitor names would go on the first X card while the fourth name would appear in Columns 13 to 25 of the second X card.

B Card

Entry 1 2	Int. Int.	2000, card identification Run number
2 3	Int.	7, number of integer entries following
4	Int.	Option number (1 to 3)
56 7 8 9	Int.	Fuel class number (0 to 99)
6	Int.	Fuel group number (0 to 99)
7	Int.	Fuel member number (0 to 99)
8	Int.	Data source number (1 to 9999)
9	Int.	Experimental condition number (1 to 9999)
10	Int.	N ₁ , number of contributors listed on following B cards (1 to 100)
11	Int.	5, number of decimal entries following
12	Dec.	Flame speed at stoichiometric conditions (cm/sec)*
13	Dec.	Maximum flame speed (cm/sec)*
13 14	Dec.	Fuel concentration at stoichiometric conditions (molecules/cc)*
15	Dec.	Fuel concentration at maximum flame speed (molecules/cc)*
16	Dec.	Equivalence ratio at maximum flame speed*

^{*}Enter 0.0 when these values are not known (i.e., for options 1 and 2)

B Card Continuation

Entry 1	Int.	2001, card identification
2	Int.	Run number
3	Int.	N ₂ , number of integer entries following (N ₂ € 10)
4 to N_2+3	Int.	Contributor code numbers
4 to N ₂ +3 N ₂ +4	Int.	N2, number of decimal entries following
N ₂ +5 to 2N ₂ +5	Dec.	Contributor count

If more than ten contributors are present, additional continuation cards may be used. For each subsequent continuation card increase the card identification number by one (1).

C Card

Entry 1 2 3 4 5	Int. Int. Int. Int. Int.	3000, card identification Run number 2, number of integer entries following Option number (1 or 2) N3, number of experiments in data group (EXPDI) or number of experimental
_	- .	runs(EXPD3)(i.e., number of D cards)
6	Int.	7, number of decimal entries following
7 8 9	Dec.	Mixture temperature (°C)
8	Dec.	Mixture absolute pressure (mm Hg)
9	Dec.	Stoichiometric oxygen ratio (atoms oxygen/molecule fuel)
10	Dec.	Mole fraction 02 in oxidant
. 11	Dec.	Volume per mole of fuel at given fuel flow rates (cc/gram-mole)
12	Dec.	Maximum allowable standard deviation in u vs. Ø curve for addition to tape (assumed 1.0 cm/sec if 0.0 entered)
13	Dec.	Actual distance between teeth tips seen on schlieren photograph (cm) (assumed to be 0.2 cm if 0.0 entered)

D Card

Entry	1 2	Int. Int.	4000, card identification
	3 4	Int.	2, number of integer entries following
	4	Int.	1, option number
	5	Int.	N ₄ , number of diameter measurements
	_		listed on continuation card (1 to 100)
	6	Int.	6, number of decimal entries following
	7	Dec.	Fuel flow at mole volume of entry 11 on C card
	8	Dec.	Oxidant flow at STP (cc/sec)
	9	Dec.	Mole fraction of inhibitor in final mixture
	10	Dec.	Measured peak height (arbitrary units)
	11	Dec.	Reference length (cm)
	12	Dec.	
	TC	Dec.	Reference length (arbitrary units)

D Card Continuation

4001, card identification Entry 1 Int. 2 Int.* Run number N₅, number of integer entries 3 Int. following 4 to $N_5 + 3$ Int.** Station height of diameter measurement (1 = cone base) $N_5 + 5$ to $2N_5 + 5$ Cone diameter (arbitrary units)

*For data processing by subroutine EXPD1, the run number on each D card must be the same as that on the A, B and C cards. For processing by routine EXPD3, the run number is to be incremented by one for each subsequent D card.

**The station heights correspond to the "teeth locations referred to in the C card description. The distance between twenty reference teeth was accurately known. As all flame speed measurements were made on a microfilm reader, it was found to be more accurate and more convenient to measure the flame diameters and teeth spacing in any suitable units (say mm) and have the computer rescale the measurements to the desired units.

E Card

Entry	1	Int.	5000, card identification
-	.2	Int.	Run number
	3	Int.	1, number of integer entries
			following
	4	Int.	2, option number
	5	Int.	No, number of flame speed -
			Sequivalence ratio entries
			(1 - 10)

E Card Continuation

Entry	1 2	Int. Int.	5001, card identification Run number
	3	Int.	<pre>1, number of integer entries following</pre>
	4	Int.	O, dummy entry
	5	Int.*	N ₃ , number of flame speed equivalence ratio entries
. 6 t	06 + N ₃	Dec.	equivalence ratio entries

*N₃ is entry 5 on the C card and must not have a value exceeding 10.

F Card 6000, card identification Entry Int. 2 Int. Run number 3 4 5, number of integer entries following Int. 4, option number Int. 5 No, number of G-card groupings to follow Int. (O to 20) (contributor count changes) Int. N7, number of entry pairs on H-card (0 to 50)(contributor name changes) 7 Int. 7, for initial tape makeup, otherwise zero 8 Int. O, for other than last data card set; 1, for last set Int. 1, number of decimal entries to follow 10 Dec. O., dummy entry G Card Entry Int. 7000, card identification 2 Int. Run number 3 4 Int. 2, number of integer entries following Int. Data group serial number 5 Int. Ng, number of entry pairs in contributor count change list (0 to 90) 6 l, number of decimal entries following Int. O., dummy entry Dec. G Card Continuation Entry 7001, card identification Int. Int. 2 Run number Int.* No, number of integer entries following 3 (d to 10) 4 to Ng+3 Int. Contributor number $N_9 + 4$ Int. Ng, number of decimal entries following

Contributor count

 N_0+5 to $4+2N_0$ Dec.

^{*}If Ng>10 additional continuation cards will be required. The card identification number must be incremented by one on each continuation card.

H Card

Columns 1 to 4	0000
13 - 16 25 - 28	contributor number contributor number
61 - 64 * < 19 - 24 31 - 36	contributor number alphabetic contributor name
31 - 36	alphabetic contributor name
67 - 72	alphabetic contributor name

*There are to be five entry pairs per H card. If N₇ from the F card is greater than 5, continue the listing on additional cards at five pairs per card.

Fortran Routine The Fortran II program is listed in Appendix A with sample printouts. Duplicate decks of this program are available.

FLAME SPEED REGRESSION

The number and type of cards comprising the data deck will depend upon the number of tests and changes wanted. To facilitate the deck makeup, each specific data card has been given an alphabetic code letter from I through U. Card types I, J, K, and T in the deck are mandatory with the K-type card containing control integers governing the number and type of all but one of the remaining cards.

Card O	Card Order			
l 2 3 Next, unless Next, unless Next, unless Next, unless Next, unless	$ \begin{array}{rcl} N_{3} &=& 0 \\ N_{4} &=& 0 \\ N_{5} &=& 0 \end{array} $	I J K L M N O P		

Card Order	Card Type
Next, unless N ₇ = 0 Next, unless N ₈ = 0	Q R
Next, unless N ₉ = 0 Next Next, unless N ₁₀ = 0	T U } *

*N₁ pairs of these cards may be used (N₁eq10). The T card contains N₁₀ and hence governs the use of the U type card.

Card Content by Card Type With exception of the I, J, R and U type cards, all input data to routine FSR are integers. A fixed format is used to accomplish this with four spaces allotted to each entry (1814). The type U cards are decomposed in subroutines VDECOM and DECDCP with the same limitations as described for routine FSC. When card column designations are given, they must be adhered to.

<u>I</u> Card - <u>Subtitle Information for Routine FSR Printout</u>

Column 1 Alpha Blank 2-72 Alpha Subtitle

J Card - Title for Regression Program Printout

Column 1 Alpha One (1) Column 2-72 Alpha Title

K Card - Routine FSR Control Card

Entry	1 2	Int. Int.	Regression run number (1 to 9999) N1, number of dependent variable choices in this run
	3	Int.	N ₂ , number of entries in input list (L card) of unacceptable data group serial numbers (O to 300)
	4	Int.	N ₃ , number of entries in input list (M card) of acceptable fuel class numbers () to 13)
	5	Int.	N4, number of entries in input list (N card) of acceptable fuel class group numbers (O to 40)
	6	Int.	N ₅ , number of entries in input list (0 card) of unacceptable fuel class-group-member numbers (0 to 80)
	7	Int.	Acceptable data source number (0 to 999, 0 means all sources acceptable)

Entry 8	Int.	Acceptable experimental conditions number (0 to 999, 0 means all conditions acceptable)
9	Int.	N ₆ , number of entry pairs in input list (P card) of contributor count tests (0 to 200)
10	Int.	N ₇ , number of entries in input list (Q card) of conditional count test criteria (0 to 6)
11	Int.	Ng, one if overriding decimal regression control data (R card) to be read; otherwise zero
12	Int.	No, number of entry pairs in input list (S card) of overriding integer regression control data (O to 7)
13	Int.	Highest contributor number in use
14	Int.	(1 to 200, higher ones ignored) 1, for the last run, otherwise zero
<u>L</u> Card		
Entry 1 to N ₂	Int.	Unacceptable data group serial numbers ($N_2 \leq 300$)
M Card		
Entry 1 to N ₃	Int.	Acceptable fuel class numbers $(N_3 \angle 20)$
${ t \underline{ t N}}$ Card		
Entry 1 to $2N_{\cup{4}}$	Int.	Acceptable fuel class-group numbers (N $_{4}$ \angle 40) paired.
O Card		
Entry 1 to 3N ₅	Int.	Unacceptable fuel class-group-members ($N_5 \stackrel{/}{\angle} 80$) in trios.
$\underline{\mathtt{P}}$ Card (see "Cont	ributor	Count Tests")
Entry 1,3 2N ₆ -1 2,4 2N ₆		Contributor number N_6 pairs Contributor count test $(N_6 \angle 200)$
<u>Q</u> Card		
Entry 1 to N ₇	Int.	Conditional count test criteria. First entry goes with test 4, second with 5, etc. $(N_7 - 6)$

R Card (see "Regression Control Data")

Columns 1 to 10 Dec. Tolerance
11 to 20 Dec. F value for

11 to 20 Dec. F value for entering variable 21 to 30 Dec. F value for removing variable

S Card (see "Regression Control Data")

Entry 1,3 2N₉-1 Int. Integer regression control item number 2,4 2N₉ Int. Overriding integer regression control data

T Card

Entry 1 Int. Dependent variable numerator identification number (1 to 6)

2 Int. Dependent variable denominator identification number (1 to 6)

3 Int. N₁₀, number of entry pairs in input list (U card) of prespecified regression coefficients for this problem (0 to 50)

<u>U</u> Card

Entry 1 Int. 1, card number 2 Int. Run number 3 Int.* N_{11} , number of integer and decimal pairs to follow 4 to $3+N_{11}$ Int. Contributor number N_{11} +4 Int. N_{11} N_{11} +5 to $4+2N_{11}$ Dec. Prespecified coefficient

*If $N_{10} > 10$ additional U type cards will be required until all of the contributor numbers and coefficients are entered. The card number must be incremented by one for each additional card.

Fortran Routine The Fortran II program for routine FSR is listed in Appendix B. Duplicate decks of this program are available.

MASTER DATA DECK LOADING AND MODIFICATION

Routine FSRTL The only data cards required by the routine are those of the master data deck itself. The card image of this deck will be read onto logical tape 6 which will then be given an end of file and rewound.

Routine FSRDM If it is desired to update the master data deck, routine FSRDM will cause any or all of the data groups on the master tape to be punched. The master tape must be logical tape 6. All control data for the routine are integers and a fixed format is used which provides a six-column field width (1216).

First control card for Routine FSRDM

Entry	1.	Int.	Number of data groups in the master data card deck
•	2	Int.	N ₁ , number of data groups which have been altered since last deck makeup
	3	Int.	Punch contributor name list? (1-yes, 2-no)
	4	Int.	Punch dependent variable name list? (1-yes, 2-no)

If none of the data groups have been modified, $N_1=0$ and the routine will punch only those data groups added since the last makeup. If $N_1 \approx 0$ an additional control card is required.

Second control card for Routine FSRDM

Entry 1 to N₁ Int. Serial number of data groups that have been modified since last deck makeup.

The Fortran II programs for routines FSRTL and FSRDM are listed in Appendix C. Duplicate decks of these programs are available.

VII. NOMENCLATURE

а	Power series fitted coefficient 2
Ã	Area of flame schlieren cone, cm ²
b	Regression coefficient
c	Number concentration, cm ⁻³
Ď	Diameter of flame schlieren cone, cm
E	
	Dependent variable scaling exponent
h -	Height above burner port, cm
n	Contributor count, no./molecule
N	A number
p q Q r R	Absolute pressure, mm Hg Volumetric flow rate, cm ³ /sec.
đ	Volumetric flow rate, cm /sec.
ଭ	Residual sum of squared differences
r	Atoms of oxygen per molecule of fuel
R	Maximum value of r subscript
S	Standard deviation
t	Temperature, ^{OC}
u	Flame speed, cm/sec.
v	Molar volume, cm ³ /g-mole
W	Molar flow rate, g-moles/sec.
x	Independent variable
У	Dependent variable
Y	Adjusted and scaled dependent variable
Z	Mole fraction
Δ	Increment prefix
y Y ~∆ (70 Ø	3.14159
Ø	Equivalence ratio

Subscripts

f	Of fuel
1	Data group index, block regression
.1	Contributor index (or number)
m	Of combustible mixture
min	At minimum of cubic fitting equation
max	At maximum flame speed
n	Height index
0	Of oxygen, or zero index
р	At peak of flame cone
q	Dummy r index
q r	Term index, u-Ø curve
ន	Specified (or prespecified)
stoc	Stoichiometric
u	Unspecified (to be calculated by regression)
x	In oxidant

Superscripts

- Calculated from a fitted equation At STP (0°C, 760 mm Hg abs.) Adjusted First derivative Second derivative

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APPENDIX A

Fortran Program and Sample Printouts for Routine FSC

EXECUTIVE ROUT	· · · · · · · · · · · · · · · · · · ·	FSCX .
	THE FOR FLAME SPEED CALCULATIONS MIC - DAYTON	FSCX
MOMENCLATURE		FSCX_FSCX_
		FSCX_
ALILI AND AZI	1) - FUEL NAME - NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE	FSCX FSCX
CHX	- FUEL CONCENTRATION AT MAXIMUM FLAME VELOCITY	FSCX
CSTOC	- FUEL CONCENTRATION AT STOICHIOMETRIC	FSCX_
	CONDITIONS_(MOLECULES / CC.)	FSCX_
DU AND TE	- FIRST AND SECOND HALVES OF DATE COUNTING INTEGERS	FSCX
ILA(I)	- FUEL CLASS NUMBER	FSCX
118(1)	- FUEL GROUP NUMBER - FUEL MEMBER NUMBER	FSCX_
12117	- DATA SOURCE NUMBER	FSCX _
13(1) J_6(U)	- EXPERIMENTAL CONDITIONS NUMBER - NUMBER OF STRUCTURAL CONTRIBUTORS CONSIDERED	FSCX FSCX
I A D D	~ NUMBER OF DATA GROUPS ACCEPTABLE FOR WRITING	FSCX
ICANT ICTL	- OPTION CONTROL INTEGER CHECK - OPTION CONTROL INTEGER	FSCX
IEXPD	EXPD SUBROUTINE SELECTION INTEGER	FSCX_
(1, (1) [18] HN1 (1, (1) [18] HN1	- INHIBITOR NAMES	FSCX FSCX
IPN	- NUMBER OF EXPERIMENTS - SPECIES CONTRIBUTOR CODE NUMBER	FSCX FSCX
KODE KODE	- SPECIES CONTRIBUTOR CODE NUMBER - SIGNAL INTEGER FOR ACCEPTABLE DATA	FSCX
NKUN	- RUN NUMBER OF DATA GROUP	FSCX .
NRUNT 	- RUN NUMBER CHECK - EQUIVALENCE RATIOS	FSCX
NUPTHH OF SK	- NUMBER OF INHIBITORS USED	FSCX
	- ATOMS OF OXYGEN TO COMPLETELY DXIDIZE ONE MOLECULE OF FUEL	FSCX
OMX	- EQUIVALENCE RATIO AT MAXIMUM FLAME YELOCITY - ABSOLUTE PRESSURE OF GAS MIXTURE (MM. MERCURY)	FSCXFSCX
STDS	<u> </u>	FSCX .
D AND DINI	O CURVE FOR ADDITION TO TAPE - EQUIVALENCE RATIO	FSCX FSCX
U AND U(N)	- FLAME SPEED (CM./SEC)	FSCX
TEETH	- ACJUAL DISTANCE BETWEEN FEETH TIPS SEEN ON SCHLIEREN PHOTOGRAPH (CM.)	FSCX
TN	- MIXTURE TEMPERATURE (DEG. C)	FSCX
UhX	- MAXIMUM FLAME SPEED (CM./SEC) - FLAME SPEED AT STOICHIGMETRIC CONDITIONS	FSCX FSCX
USTOC	(CM./SEC)	FSCX
USTOC	(CM-/SEC) (CM-/SEC) (CC-/GRAH-HOLE)	FSCX .
VSTOC VSFO VSF	(CM./SEC) - YOLUME PER MOLE OF FUEL. (CC./GRAH-MOLE) - YOLUME PER MOLE OF MIXTURE (CC./GRAH-MOLE) - MOLE FRACTION OXYGEN IN OXIDAME ., IC, J11, J2, J3, NIN, NEX (10), DEC(10)	FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VSTOC VBFO VBF VOX COMMON INT, DEC DIMENSION INT DIMENSION A1- 1 112 2 ,INM.	(CM./SEC)	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBPO VBR VOX COMMON INT, DEC DIMENSION INT DIMENSION A1 1 [1] 2 INM NIN = 1 20 IADD = 0	(CM./SEC)VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE)VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE)MOLE FRACTION OXYGEN IN. OXIDANL 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100,20), DA(6,20), TIA(20), TIB(20), TIA(20), JII(100,20), O(10), U1(0)	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBPO VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION A1 1 11 2 1NM NIN = 1 20 IADD = 0 30 CALL INPUL NEX = NEX	(CM./SEC) - YOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - YOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT ; IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20),42(20),81(100,20),DA(6,20),TIA(20),118(20), (120),12(20),13(20),14(20),J1(100,20),O(10),U(10) (B1(10,20), IMM(82(10,20)	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBFO VBA VOX COMMON INT, DEC DIMENSION INT DIMENSION A1 1 11 2 INM NIN = 1 20 IADD = 0 30 CALL INPUE NEX = NEX	(CM./SEC)VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE)VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE)MOLE FRACTION OXYGEN IN. OXIDANL 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100,20), DA(6,20), TIA(20), TIB(20), TIA(20), JII(100,20), O(10), U1(0)	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBFO VBA VOX COMMON INT, DEC DIMENSION INT DIMENSION A1 1 11 2 INM NIN = 1 20 IADD = 0 30 CALL INPUE NEX = NEX	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT , IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) BE1(10, 20), INH(62(10, 20))	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VBFO VBR VOX COMMON INT, DEC OIMENSION INT OIMENSION A1- 1 11- 20 IADO = 0 30 CALL INPUT NEX = NEX GO TOL 31, 521. A CARD ASSIGNI	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT , IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) BE1(10, 20), INH(62(10, 20))	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VSTOC VBFO VBR VOX COMMON INT, DEC OIMENSION INT OIMENSION A1- 1 114 20 IADO = 0 30 CALL INPUT NEX = NEX GO TOL 31, 321 A CARD ASSIGNI 31 NRUN = JII ICTL = INT(1)	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT , IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) BE1(10, 20), INH(62(10, 20))	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOG VBF VBM VOX COMMON INT, DEC OIMENSION INT OIMENSIO	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT 1, IC, J11, J2, J3, NIN, NEX (101, DEC(10) (201,42(20),81(100,20),DA(6,20),TIA(20),TIB(20), (1(20),12(20),13(20),14(20),J1(100,20),O(10),U(10) (B1(10,20), IMHIB2(10,20) 7 701, 300, 901, 300, 300, 300), MEX	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBFO VBR VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT OWNERS ON THE PO 1400 = 0 30 CALL INPUT NEX = NEX GO TOL 31, 521, A CARD ASSIGNI 31 NRUM = J11 ICTL = INT(1) IEXPO = INT(2) NUMINH = INT(3) HAXON = INT(4) IF (NRUN) 32,2;	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAH-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAM! (10), DEC(10) (20), 2(20), 61(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 2(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) B1(10, 20), INH(62(10, 20)) 701, 300, 901, 300, 300, 300), MEX MEMIS	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VSTOC VBF0 VBB VBB VOX COMMON INT, DEC OIMENSION INT OIMENSION INT OIMENSION A1- 1 1 11 20 IADD = 0 30 CALL INPUT NEX = NEX GO TOL 31, 521- A.CARD. ASSIGNI 31 NRUM = J11 ICTL = INT(1) IEXPD = INT(2) NUMINH = INT(3) AAXON = INT(4) JF (NRUM) 32,2 JF (NRUM) 32,2 JF (NRUM) 182,2 JF (NRUM) 182,2	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT ; IC, J11, J2, J3, NIN, NEX (101, DEC(10) (201,82(20),81(100,20),DA(6,20),TIA(20),IIB(20), (120),12(20),13(20),14(20),J1(100,20),O(10),U(10) B1(10,20), INH(82(10,20) , 701, 300, 901, 300, 300, 300), MEX MENTS	
VSTOC VBF0 VBF0 VBM VOX COMMON INT, UEC DIMENSION INT DIMENSION A1- 1 1(1) 20 IADD = 0 30 CALL INPUT NEX = NEX GO TO(13), 521- A_CARD ASSIGN 31 NRUM = J11 ICTL = INT(1) IERPO = INT(2) MUMINH = INT(3) MAXON = INT(4) IF (NRUM) 32,2 32 IF (NUMINH) 320,2 00 NUMINH = I	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT ; IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), TIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), INH(82(10, 20) , 701, 300, 901, 300, 300, 300), MEX MENTS	
USTOC VBF0 VBF0 VBM VOX COMMON INT, UEC DIMENSION INT DIMENSION A1- 1 1(1) 20 IADD = 0 30 CALL INPUT NEX = NEX GO TOL 31, 521- A CARD ASSIGN 31 NRUM = J11 ICTL = INT(1) IERPO = INT(2) MANON = INT(4) JE (NRUM) 32,2 JE (NRUM) 182,2 JE (FNUMINH) 320,2 JE (FNUMINH) 32,2	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT ; IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), TIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), INH(82(10, 20) , 701, 300, 901, 300, 300, 300), MEX MENTS	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) B1(10, 20), IMM(82(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 1 10, 32 , 320, 33 IDM	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VBFO VBFO VBFO VBFO VBF VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT I	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J1(100, 20), O(10), U1(0) B1(10, 20), IMM(82(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 1 10, 32 , 320, 33 IDM	
VBFO VBFO VBFO VBFO VBM YOX COMMON INT, DEC DIMENSION INT DIMENSION INT I 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(CM./SEC) - YOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - YOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT C, IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20), 2(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 2(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), INH(82(10, 20) , 701, 300, 901, 300, 300, 300), NEX MENTS 1 100, 32 , 320, 33 100	
VBFO VBFO VBFO VBFO VBF VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT I	(CM./SEC) - YOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - YOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT C, IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20), 2(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 2(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), INH(82(10, 20) , 701, 300, 901, 300, 300, 300), NEX MENTS 1 100, 32 , 320, 33 100	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
USTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT ON THE STORY A CARD ASSIGN 31 NRUN = JI ICTL = INT(1) ICTL = I	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J(100, 20), O(10), U(10) B1(10, 20), IMM(82(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 1 10, 32 , 320, 33 IDM NO, 150, 30 NG E 2, 1002	FSCX FSCX FSCX FSCX FSCX FSCX FSCX FSCX
VSTOC VBFO VBR VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT OWNERS ON INT 20 1ADD = 0 30 CALL INPUT NEX = NEX GO TO(1 3), 521, A CARD ASSIGNI 31 NRUM = J11 ICTL = INT(1) IEXPD = INT(2) NUMINH = INT(3) 1F (NRUM) 32, 22 ONUMINH = IT 32 IF (NUMINH) 320 ONUMINH = IT 33 IF (ICTL - 4) 40 IF (ICTL) (C) 50 I = IADD + 1 X CARD READII 52 READ INPUT TAPI 9	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDANT C, IC, J11, J2, J3, NIN, NEX (101, DEC(10) (20), 22(20), 81(100, 20), DA(6, 20), TIA(20), TIB(20), (120), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), INNIB2(10, 20) , 701, 300, 901, 300, 300, 300), NEX MENTS 1 100, 32 , 320, 33 IDM	
USTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT ON THE STORY A CARD ASSIGN 31 NRUN = JI ICTL = INT(1) ICTL = I	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 1, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J(100, 20), O(10), U(10) B1(10, 20), IMM(82(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 1 10, 32 , 320, 33 IDM NO, 150, 30 NG E 2, 1002	
USTOC VBF0 VBP VBP VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 14(20), J1(100, 20), O(10), U(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (1	FSCX FSCX
VSTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON ON INT ON	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 2, IC, JII, JZ, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), T1A(20), [18(20), (120), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) B1(10, 20), IMM(82(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 1004 40, 150, 30 62, 1002 (1), A2(1), DU, TF , (IMM(INI(J, I), IMM(IS2(J, F), J=1,) MENTS	FSCX FSCX
USTOC VBFO VBFN VOX COMMON INT, DEC DIMENSION INT, ON CALL INPUT NEX = NEX GO TO(31, 521, A CARD ASSIGN 31 NRUN = JII ICTL = INT(1) IEXPO = INT(2) NUMINH = INT(3) ACARD ASSIGN 32 IF (NUMINH) 320, ONDINH " OPTION SELECT 33 IF (ICTL - 4) 40 IF (ICTL - 4)	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAM! 2, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), TIA(20), IB(20), (120), J2(20), J3(20), J4(100, 20), O(10), U(10) (120), J2(20), J3(20), J4(100, 20), J4(100, 20), O(10), U(10) (120), J3(20), J3(20), J4(100, 20), J4(100, 20), O(10), U(10) (10), J4(1), J4(1)	FSCX FSCX
USTOC VBFO VBFN VOX COMMON INT, DEC DIMENSION INT, ON CALL INPUT NEX = NEX GO TO(31, 521, A CARD ASSIGN 31 NRUN = JII ICTL = INT(1) IEXPO = INT(2) NUMINH = INT(3) ACARD ASSIGN 32 IF (NUMINH) 320, ONDINH " OPTION SELECT 33 IF (ICTL - 4) 40 IF (ICTL - 4)	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAM! 2, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), TIA(20), IB(20), (120), J2(20), J3(20), J4(100, 20), O(10), U(10) (120), J2(20), J3(20), J4(100, 20), J4(100, 20), O(10), U(10) (120), J3(20), J3(20), J4(100, 20), J4(100, 20), O(10), U(10) (10), J4(1), J4(1)	
VSTOC VBFO VBP VBP VBP VBP VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT OTHER OTH	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI 1, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), A2(20), B1(100, 20), DA(6, 20), TIA(20), IIB(20), (120), I2(20), I3(20), I4(20), J1(100, 20), O(10), U(10) B1(10, 20), INH(62(10, 20) 701, 300, 901, 300, 300, 300), MEX MENTS 100 40, 150, 30 NG E 2, 1002 (1), A2(11, DU, Tf , (IMMIRITY, I), IMMIB2(J, F), J=1, MENTS 2000 3, 522, 523	FSCX FSCX
USTOC V8FO V8FM V8FM V8FM V8FM V8FM V8FM V8FM V8FM	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (10), DEC. (10) (20), A2(20), B1(100, 20), DA(6, 20), TIA(20), [IB(20), (I20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) (20), A2(20), B1(100, 20), DA(6, 20), TIA(20), [IB(20), (I20), 14(20), J1(100, 20), O(10), U(10) (20), A2(20), B1(100, 20) (20), A2(20), B1(20) (20), A2(20), B1(20),	FSCX FSCX
USTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT ICTL = INT(1) ICTL = INT(2) DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT INUMINHI SO I = INDO N INUMINHI INUMI	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) BELLIO, 20), INHIB2(10, 20) 7 701, 300, 901, 300, 300, 300), MEX MERTS 100 NG E 2, 1002 (1), A2(1), DU, TF (INHIBI(3,1), INHIB2(3,F), J-1, MENTS 2000 3, 522, 523	FSCX FSCX
USTOC VBFO VBR VOX COMMON INT, DEC DIMENSION INT ICTL = INT(1) ICTL = INT(2) DIMININH = INT OPTION SELECT 33 IF (ICTL - 4) 40 IF (ICTL -	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF HIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 13(20), 13(20), 14(20), J1(100, 20), O(10), U(10) BELLIO, 20), INH(62(10, 20) 701, 300, 901; 300, 300, 300), MEX MERTS (1) NG E 2, 1002 (1), A2(11, DU, Tf , (INK(IR)(1), I), INM(182(J, I), J-1,) MENTS 2000 3, 522, 523	FSCX FSCX
USTOC VBFO VBM VOX COMMON INT, DEC DIMENSION INT, DO 1ADD = 0 30 CALL INPUT NEX = NEX GO TO(31, 521, A CARD ASSIGNI 31 NRUM = JII ICTL = INT(1) IEXPO = INT(2) MMINH = INT(3) IF (NUMINH) 32,0 20 NUMINH = INT(3) 32 IF (NUMINH) 32,0 30 NUMINH = INT(3) 40 IF (ICTL - 4) 40 I	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) BELLIO, 20), INHIB2(10, 20) 701, 300, 901, 300, 300, 300), MEX MERTS (1) 100 NG E 2, 1002 (1), A2(11, DU, Tf , (INHIBI(3,1), INMIB2(3,T), J-1,	FSCX
VSTOC VBFO VBB VBB VBB VBB VOX COMMON INT, DEC DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT DIMENSION INT I (1) 20 IADD = 0 30 CALL INPUT NEX = NEX GO TOI 31, \$21 A CARD ASSIGN 31 NRUN = JIL ICTL = INT(1) IEXPD = INT(2) NUMINH = INT(3) ACARD ASSIGN 32 IF(NUMINH) IF (NRUN) 32, 2 32 IF(NUMINH) IF (ICIL - 4) 90 IF (ICIL - 4) 150 I = IADD + 1 X CARD READI 32 READ INPUT TAPI 90 IF (ICIL - 4) 91 INUMINH) GO TO 30 21 NUMCON = IC - 1 16 (MUMCON) 52 22 MUMY = JIL ICANF = INT(1) ICIL = INT(2) IS(II) = INT(3) IS(II)	(CM./SEC) - VOLUME PER MOLE OF FUEL. (CC./GRAM-MOLE) - VOLUME PER MOLE OF MIXTURE (CC./GRAM-MOLE) - MOLE FRACTION OXYGEN IN OXIDAMI (, IC, JII, J2, J3, NIN, NEX (10), DEC(10) (20), 82(20), 81(100, 20), DA(6, 20), TIA(20), IIB(20), (20), 12(20), 13(20), 14(20), J1(100, 20), O(10), U(10) BELLIO, 20), INHIB2(10, 20) 701, 300, 901, 300, 300, 300), MEX MERTS (1) 100 NG E 2, 1002 (1), A2(11, DU, TF , (INHIBI(3,1), INMIB2(3,T), J-1,	FSCX FSCX

FLAME SPEED CALCULATION EXECUTIVE PROGRAM PRINTOUT OF INPUT DATA RUN NUMBER CONSISTENCY CHECK CONTROL INTEGER CHECK FSCX FSCX FSCX FSCX FSCX 55 IF LICTL - ICANT) 200,60,200 OPTION SELECTION 60 IF LICTL - 2) 70.70.120 70 GO TO 30 C CARD ASSIGNMENTS 701 NRUNT = JIT | JCANT = INT(1) | IPN = INT(2) | TM = .DEC(1) | PM = .DEC(2) | OFSR = .DEC(3) | YOX = .DEC(4) | VHED = .DEC(5) OFSR = UEC.(3). YOX = DEC.(4). VHFO = DEC.(5). SIDS = DEC.(6). TEETH = UEC.(7). WRITE OUIPUT TAPE 3,1017. WRITE OUIPUT TAPE 3,1019. 9 , IM,PM,OFSR,YOX,VBFO RUN NUMBER CUNSISTENCY CHECK IF (NRUN - NRUNT) 200,71,200 CONTROL INTEGER CHECK FSCX FSCX FSCX FSCX EXPERIMENTAL DATA PROCESSING 1 NNUNI ; GO TC 84 83 CALL EXPOSINAUN,ICTL,OFSR,VOX,V&FO ,VBM, IPN, Q, U, KODE, TEETH , 1 NRUNT) 84 IF (KODE -3) 81,100, 81 90 GD TC 30 E CARD ASSIGNMENTS 901 NUMCCN = 1C - 5000 1F(NUMCON) 904, 902, 904 902 NRUNT = 111 1CANT = 1NT(1) D0 903 N = 1, 1PN 903 O(N) = DEC(N) G0 T0 30 904 D0 905 N = 1, 1PN 909_U(N) = DEC(N) RUN NUMBER CONSISTENCY CHECK 1F (NRUN - NRUNT) 200,91,200 CONTROL INTEGER CHECK ç 91 [F [1CTL -]CANT] 200.100.200 DETERMINATION OF MAXIMUM FLAME SPEED. 100 CALL MAXM (IPN, O. U. OMX, UMX, USTOC, KODE, STOS, IEXPD, MAXOM, TEST FOR SUCCESSFUL DETERMINATION OF MAXIMUM FLAME SPEED IF (KODE - 3) 30,110,30 TEST FOR REASON FOR UNSUCCESSFUL DETERMINATION OF MAX SPEED 81 IF (ROSE - 1) 30,200,30 110 CMX - 6.0238E23/(VBM-(11.0 + OFSR/(OMX-YOX-2.01))

STORAGE OF ACCEPTABLE DATA	FLAME SPEED CALCULATION EXECUTIVE PROGRAM	· 	
STORAGE OF ACCEPTABLE DATA	The same of the sa	##CY	213
DAI2; = USTOC	C STORAGE OF ACCEPTABLE DATA	FSCX	214
DAIS; - UST - CSTOC FEEL 2 DAIS; - CSTOC FEEL 2 DAIS; - CSTOC FEEL 2 FEEL 2	C DA(2,1) = USTOC		- 215 216
DAIS, 11 - CMM DAIGH 11 - ONM PSCX 2 120 LADD - LADD - L PRINTOUL OF ACCEPTABLE DATA C PRINTOUL OF ACCEPTABLE DATA SCX 2 WRITE OUTPUT TAPE 3, 1020 WRITE OUTPUT TAPE 3, 1020 WRITE OUTPUT TAPE 3, 1021 G TO 30 C TAPE EDITING AND WRITING SCX 2 L LADD, DU, 1E, LAST! SCX 2 FSCX 2	DA(3,1) = UMX		217 218
120 1ADD - 1ADD -	DA(5,1) = CMX	FSCX	219
MRITE OUTPUT TAPE 3, 1020 FSCX 2 MRITE OUTPUT TAPE 3, 1012 MRITE OUTPUT TAPE 3, 1012 MRITE OUTPUT TAPE 3, 1013 FSCX 2 FSCX 2 MRITE OUTPUT TAPE 3, 1013 FSCX 2 FSCX 2 MRITE OUTPUT TAPE 3, 1013 FSCX 2 MRITE OUTPUT TAPE 3, 1013 FSCX 2 MRITE OUTPUT TAPE 3, 1014 FSCX 2 MRITE OUTPUT TAPE 3, 1016 FSCX 2 MRITE OUTPUT TAPE 3, 1016 FSCX 2 MRITE OUTPUT TAPE 3, 1020 FSCX 2 MRITE OUTPUT TAPE 3, 1020 FSCX 2 MRITE OUTPUT TAPE 3, 1016 MRITE OUTPUT TAPE		FSCX	_221.
WRITE OUTPUT TAPE 3, 1020 SCC. 2 WRITE OUTPUT TAPE 3, 1012 WRITE OUTPUT TAPE 3, 1013 WRITE OUTPUT TAPE 3, 1013 SCC. 2 SCC. 2 WRITE OUTPUT TAPE 3, 1013 SCC. 2 S	C PRINTOUT OF ACCEPTABLE DATA		222
WRITE OUTPUT TAPE 3, 1012 WRITE OUTPUT TAPE 3, 1013 WRITE OUTPUT TAPE 3, 10131 WRITE OUTPUT TAPE 3, 10131 GO TO 30 WRITE OUTPUT TAPE 3, 10131 GO TO 30 LORALILIA, 118[1], 116[1], 112[1], 12[1], 12[1] GO TO 30 LORALILIA, 12, 10131 FSCX 2 FSCX 2 FSCX 2 FSCX 2 FSCX 2 FSCX 2 LORALILIA, 12, 1114, 118, 116, 116, 116, 116, 116, 116, 116	· · · · · · · · · · · · · · · · · · ·		224
MRITE OUTPUT TAPE 3, 1013 WRITE OUTPUT TAPE 3, 10131 GO TO 30 (100ALL)LRE2,10) FSCX 2 FSCX 2 GO TO 30 (100ALL)LRE2,10) FSCX 2 TAPE EDITING AND WRITING FSCX 2 150 CALL TAPE (MRUN, ICTL, AI, AZ, IIA, 118, IIC, IZ, T3, 0A, I4, J1, B1, FSCX 2 TEST FOR COMPLETION OF TAPE EDITING AND WRITING FSCX 2 FILLAST, LS1, Z0, LS1 FSCX 2 FILLAST, LS1, Z0, LS1 FSCX 2 GO TO Z0 GO TO Z0 C ERROR PRINT - RUN NUMBER OR CONTROL INTEGER INCONSISTENCY FSCX 2 TO WRITE OUTPUT TAPE 3, 1016 FSCX 2 C DIAGNOSTIC - UNACCEPTABLE CARD ORDER FSCX 2 GO TO Z0 C DIAGNOSTIC - UNACCEPTABLE CARD ORDER FSCX 2 GO TO Z0 C FORMAT STATEMENTS FSCX 2 GO TO Z0 C FORMAT STATEMENTS FSCX 2 GO TO Z0 C FORMAT STATEMENTS FSCX 2 FSCX	WRITE OUTPUT TAPE 3, 1012	FSCX	226
WRITE OUTPUT TARE 3, 10131 9	WRITE OUTPUT TAPE 3, 1013	FSCX	228
GO TO 30 GO TO 30 GO TO 30 C TAPE EDITING AND WRITING FSCX 2 TAGE (NRUN, ICTL, AI, A2, IIA, 118, IIC, 12, 13, 0A, 14, J1, 81, 55CX 2 LISO CALL TAPE (NRUN, ICTL, AI, A2, IIA, 118, IIC, 12, 13, 0A, 14, J1, 81, 55CX 2 LISO CALL TAPE (NRUN, ICTL, AI, A2, IIA, 118, IIC, 12, 13, 0A, 14, J1, 81, 55CX 2 LISO CALL TAPE (NRUN, ICTL, AI, A2, IIA, 118, IIC, 12, 13, 0A, 14, J1, 81, 55CX 2 LISO RATE DUTPUT LAPE SALOSO GO TO TAGE (NRUN, ICTL, AI, A2, IIA, 118, IIC, 12, IIA, 118, IIC, 12, IIA, 181, IIIA, 181, IIIA, 181, IIIA, 181, IIIA, 181, IIIA, IIIA, 181, IIIIA, 1	9 . 11A(1), 11B(1), 11C(1), 12(1), 13(1)		224
C TAPE EDITING AND WRITING	9 (DA(K,I),K=2,6)	FSCX	231 232
150 CALL TAPE (NRUN; ICTL, A1, A2, 114, 118, 11C, 12, 13, 0A, 14, J1, 81, FSCX 2 1A0D, DU, TE, LAST) FSCX 2 1A0D, DU, TE, LAST) FSCX 2 FSCX 2 FSCX 1 FSCX 2		FSCX	_233
TADD, DU, TE, LAST FSCX 2	C TAPE EDITING AND WRITING	FSCX _	234 235
C TEST FOR COMPLETION OF TAPE EDITING AND WRITINS			236
IFILAST 151,20,151	C	FSCX	238
TSI REMIND SECK 2 20 MRITE OUTPUT TAPE 3, 1030 FSCK 2 20 MRITE OUTPUT TAPE 3, 1016 FSCK 2 5 5 5 5 5 5 5 5 5	C	FSCX	_234 _240
200 MRITE OUTPUT TAPE 3, 1030		FSCx "	- 241 242
C ERROR PRINT - RUN NUMBER OR CONTROL INTEGER INCONSISTENCY	210 WRITE OUTPUT TAPE 3, 1030		243 244
C 200 WRITE DUTPUT TAPE 3, 1016 FSCX 2	C	FSCX	_245 _246
GO TO 30 C DIAGNOSTIC - UNACCEPTABLE CARD ORDER C DIAGNOSTIC - UNACCEPTABLE CARD ORDER C SCX 2 SCX 2 NIN = 2 GO TO 30 C FORMAT STATEMENTS C FORMAT STATEMENTS C FORMAT (12x, 10A6) 1010 FORMAT (12x, 10A6) 1010 FORMAT (12x, 10A6) 1011 FORMAT (12x, 10A6) 1010 FORMAT (12x, 10A6) 1011 FORMAT (12x, 10A6) 1012 FORMAT (12x, 10A6) 1013 FORMAT (12x, 10A6) 1014 FORMAT (12x, 10A6) 1015 FORMAT (12x, 10A6) 1017 FORMAT (12x, 10A6) 1018 FORMAT (12x, 10A6) 1019 FORMAT (12x, 10A6) 1011 FORMAT (12x, 10A6) 1012 FORMAT (12x, 10A6) 1013 FORMAT (12x, 10A6) 1014 FORMAT (12x, 10A6) 1015 FORMAT (12x, 10A6) 1016 FORMAT (12x, 10A6) 1017 FORMAT (12x, 10A6) 1018 FORMAT (12x, 10A6) 1019 FORMAT (12x, 10A6) 1010 FORMA	C	FSCX	247
C DIAGNOSTIC - UNACCEPTABLE CARD ORDER	200 WRITE DUTPUT TAPE 3, 1016		248
C DIAGNOSTIC - UNACCEPTABLE CARD ORDER C SOL 2 G SOL WRITE OUTPUT TAPE 3, 3000, IC, J11 FSCX 2 GO TO 30 FSCX 2 GO TO 30 FSCX 2	GO 10 30	FSCX	250 251
SOO MATTE GUTPUT TAPE 3, 3000, IC, J11	C DIAGNOSTIC - UNACCEPTABLE CARD ORDER	FSCX	252
SCX 2 GO TO 30 FSCX 2	300 WRITE OUTPUT TAPE 3, 3000, IC, J11		. 253 254
C FORMAT STATEMENTS	NIN = 2		255 256
C		FSCX	257 258
1010 FORMAT 97HMOMSANTO RESEARCH CORPORATION FLAME SPEED CALCULATI FSCK 2 9 (1H1. 97HMOMSANTO RESEARCH CORPORATION FLAME SPEED CALCULATI FSCK 2 1010M - ROUTIME 2018 MODIFICATION 1 RUM 14 6H DATE 2A6 J FSCK 2 FSCK 2 9 (1M0, 25X,10H1NPUT_DATA_) FSCK 2 7 FSCK 2 1 1M0, 30X, 9HFUEL NAME , 35X, 15H1NH181TORS USED // FSCK 2 1 1M0, 30X, 2A6, 32X,2A6 /(1H0, 74X, 2A6)) FSCK 2 1 1M0, 30X, 2A6, 32X,2A6 /(1H0, 74X, 2A6)) FSCK 2 1 1M0, 30X, 2A6, 32X,2A6 /(1H0, 74X, 2A6)) FSCK 2 1 1M0, 10X, 18HFUEL CROOUP NUMBER 3X, 16, 11X, FSCK 2 1 1M0, 10X, 18HFUEL CROOUP NUMBER 3X, 16, 11X, FSCK 2 1 1M0, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X, FSCK 2 1 1M0, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X, FSCK 2 1 1M0, 10X, 2MHFUEL MEMBER NUMBER 3X, 16, 1X, FSCK 2 1 1M0, 10X, 2MHFUEL MEMBER NUMBER 3X, 16, 1X, FSCK 2 1 1M0, 10X, 2MHFUEL CONCULTY AT STOICHIONETRIC CONCENTRATION RATI FSCK 2 1 1M0, 10X, 4MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 4MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCK 2 1 1M0, 10X, 5MHFUEL CONCENTRATION CODE NUMBER FROM 1 1 1XX, 43HHUMBER DF CONTRIBUTORS PER HOLECULE OF FUEL 1 FSCK 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	č	FSCX	259
9 (1M1, 97HHOMSANTO RESEARCH CORPORATION FLAME SPEED CALCULATI FSCX 2 (10) - ROULINE 2018 MODIFICATION 1 RUM 14.6H DATE 2A6.) FSCX 2 (110) FORMAT FSCX 2 (110) FSCX	1010 FORMAT	FSCX	260 261
1011 FORMAT 9 (1MO, 25X,10MINPUT_DATA) 175CX 2 1012 FORMAT 9 (1MO, 30X, MFUEL NAME, 35X, 15MINMIBITORS USED // FSCX 2 1 1MO, 30X, 2A0, 32X,2A6 /(1MO, 74X, 2A6)) 1013 FORMAT 9 (1MO, LOX, 18MFUEL CLASS NUMBER 3X, 16, 11X, FSCX 2 1 1 18MFUEL GROUP NUMBER 3X, 16, 11X, FSCX 2 2 18MFUEL MEMBER NUMBER 3X, 16, 11X, FSCX 2 3 1MO, 10X, 18MDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 3 1MO, 10X, 18MDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 1013 FORMAT 9 (1MO, LOX, 18MDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 10 10 3X, F9.4, 9X, THCM./SEC / FSCX 2 2 1MO, 10X, 22MMAXIMUM FLAME VELOCITY AT STOICHIOMETRIC CONCENTRATION RATI FSCX 2 2 1MO, 10X, 22MMAXIMUM FLAME VELOCITY , 33X, F9.4,9X.7HCM./SEC / FSCX 2 3 1MO, 10X, 47HFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 4 10X, E13.6 3X, 13MPOLECULES/CC / FSCX 2 5 1MO, 10X, 52MFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCX 2 6Y, X,E13.6, 3X, 13MPOLECULES/CC / FSCX 2 7 1MO, 10X, 40MEQUIVALENCE RATIO AT MAXIMUM FLAME SPEED 16X,F9.5) FSCX 2 1015 FORMAT FSCX 2 1015 FORMAT FSCX 2 1 17X, 43HMUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL) FSCX 2 1 14X 20MHISPLACED RUN NUMBER 14, FSCX 2 1 14X 20MHISPLACED RUN NUMBER 14, FSCX 2 1 14X 22MDPTION CONTROL INTEGER CHECK 14) FSCX 2 1 14X 22MDPTION CONTROL INTEGER CHECK 14) FSCX 2 1 1015 FORMAT FSCX 2 1 1015 FORMAT FSCX 2 1 1016 FORMAT FSCX 2 1 1017 FORMAT FSCX 2 1 1018 FORMAT FSCX 2 1 1019 FORMAT FSCX 2 1	9 (1H1. 97HMONSANTO RESEARCH CORPORATION FLAME SPEED CALCULATI		262 263
1012 FORMAT 9 (1 HO, 30X, 9HFUEL NAME, 35X, 15HINHIBITORS USED // FSCX 2 1 1 HO, 30X, 2A0, 32X;2A6 /(1HO, 74X; 2A6)) FSCX 2 1013 FORMAT 9 (1HO, LOX, 18HFUEL CLASS NUMBER 3X, 16, 11X, FSCX 2 1 1 18HFUEL GROUP NUMBER 3X, 16, 11X, FSCX 2 2 18HFUEL HEMBER NUMBER 3X, 16, 11X, FSCX 2 3 1HO, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 3 1HO, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 4 1013 FORMAT 9 (1HO, LOX, 52HFLAME YELOCITY AT STOICHIOMETRIC CONCENTRATION RATI FSCX 2 2 1HO, 10X, 22HMAXINUM FLAME VELOCITY, 33X, F9.4.9X.THCM./SEC / FSCX 2 3 1HO, 10X, 47HFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 4 10X, E13.6 3X, 13HMOLECULES/CC / FSCX 2 5 1HO, 10X, 52HFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCX 2 6Y, 5X, E13.6, 3X, 13HMOLECULES/CC / FSCX 2 7 1HO, 10X, 40HEQUIVALENCE RATIO AT MAXIMUM FLAME SPEED 16X,F9.5) FSCX 2 1015 FORMAT FSCX 2 1015 FORMAT FSCX 2 1 17X, 43HMUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL) FSCX 2 1 1014 FORMAT FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 14X 2 CONMISPIACED RUN NUMBER 14, FSCX 2 1 1015 FORMAT FSCX 2 1 1016 FORMAT FSCX 2 1 1017 FORMAT FSCX 2 1 1018 FORMAT FSCX 2 1 1019 FORMA	1011 FORMAT	FSCX	264
1 (1 HO, 30X, 9HFUEL MANÉ , 35X, 15HIMHIBITORS USED // FSCX 2 1 1 HO, 30X, 2AG, 32X,2AG /(1MO, 7AX, 2AG)) FSCX 2 1 1 18HFUEL GROUP NUMBER 3X, 16, 11X , FSCX 2 1 18HFUEL GROUP NUMBER 3X, 16, 11X , FSCX 2 3 1HO, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X , FSCX 2 3 1HO, 10X, 18HDATA SOURCE NUMBER 3X, 16, 11X , FSCX 2 4 30HEXPERIMENTAL CONDITIONS NUMBER 3X, 16, 11X , FSCX 2 10.131 FORNAT FSCX 2 10.101 FORNAT FSCX 2 2 1HO, 10X, 52HFLAME YELDCITY AT STOICHIOMETRIC CONCENTRATION RATI FSCX 2 1 10, 3X, F94, 9X, THCM./SEC / FSCX 2 2 1HO, 10X, 22HMAXINUM FLAME YELDCITY AT STOICHIOMETRIC CONDITIONS FSCX 2 3 1HO, 10X, 4THFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 4 10X, E13.6, 3X, 13HMOLECULES/CC, FSCX 2 5 1HO, 10X, 52HFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 5 1HO, 10X, 50HFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM YELDCIT FSCX 2 6Y 5X,E13.6, 3X, 13HMOLECULES/CC, FSCX 2 1015 FORNAT FSCX 2 1 17X, 43HHUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL FSCX 2 1 17X, 43HHUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL FSCX 2 1 1 1 14X, 20HMISPLACED RUN NUMBER 14, FSCX 2 2 1 1HO, 16X, 30HDAIA QUI OF ORDER - AUM NUMBER 14, FSCX 2 3 1 1AX, 20HMISPLACED RUN NUMBER 14, FSCX 2 1 1 14X, 20HMISPLACED RUN NUMBER 14, FSCX 2 2 1 1HO 16X, 22HOPTION CONTROL INTEGER CHECK 14) FSCX 2 3 1 2 22X, 21HCONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 22HDATION CONTROL INTEGER CHECK 14) FSCX 2 5 1HO 16X, 2	•		265 266
1013 FORMAT 9 (1H0, 10x, 18MFUEL CLASS NUMBER 3X, 16, 11X, FSCX 2 1 18MFUEL GROUP NUMBER 3X, 16, 11X, FSCX 2 2 18MFUEL GROUP NUMBER 3X, 16, 11X, FSCX 2 3 1H0, 10X, 18MDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 3 1H0, 10X, 18MDATA SOURCE NUMBER 3X, 16, 11X, FSCX 2 4 30MEXPERIMENTAL CONDITIONS NUMBER 3X, 16, 11X, FSCX 2 10.131 FORMAT FSCX 2 9 (1H0, 10X, 52MFLAME YELDCITY AT STOICHIOMETRIC CONCENTRATION RATI FSCX 2 10, 3X, F94, 9X, 7TMCN./SEC FSCX 2 110, 10X, 22MMAXINUM FLAME YELDCITY AT STOICHIOMETRIC CONCENTRATION RATI FSCX 2 1 100, 10X, 47MFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 1 10X, 10X, 52MFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS FSCX 2 5 1100, 10X, 52MFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM YELDCIT FSCX 2 5 1100, 10X, 52MFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM YELDCIT FSCX 2 5 1100, 10X, 52MFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM YELDCIT FSCX 2 5 110, 10X, 93MFUELCUES/CC, FSCX 2 1015 FORMAT FSCX 2 1 17X, 93MHUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL FSCX 2 1 17X, 93MHUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL FSCX 2 1 1 1 14X, 20MMISPLACED RUN NUMBER 14, FSCX 2 2 / 110 16X, 22MODATA QUI OF ORDER - AUM NUMBER 14, FSCX 2 2 / 110 16X, 22MODATA QUI OF ORDER - AUM NUMBER 14, FSCX 2 3 2 2X, 21MCONTROL INTEGER CHECK 14) FSCX 2 1017 FORMAT FSCX 2 1017 FORMAT FSCX 2 1017 FORMAT FSCX 2 1018 FORMAT FSCX 2 1019 FORMAT FSCX 2 1010 FORMAT FSCX 2 1011 FORMAT FSCX 2 1011 FORMAT FSCX 2 1012 FORMAT FSCX 2 1012 FORMAT FSCX 2 1013 FORMAT FSCX 2 1014 FORMAT FSCX 2 1015 FORMAT FSCX 2 1017 FORMAT FSCX 2 1017 FORMAT FSCX 2 1018 FORMAT FSCX 2 1019 FORMA	9 (1HO, 30X, 9HFUEL NAME , 35X, 15HINHIBITORS USED //	" FSCX	267 268
1	1013 FORMAT	FSCX	269
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10131 FORMAT	2 18HFUEL MEMBER NUMBER 3X, 16, /		272 273
9 (11H), 10X, 52HFLAME_VELOCITY AT STOICHIOMETRIC_CONCENTRATION_RATI	4 30HEXPERIMENTAL CONDITIONS NUMBER 3X-16)	FSCX	274
10 , 3x, F9.4, 9x, THCM./SEC / FSCx 2 2 140,10x, 224MAXINUM FLAME VELOCITY , 33x, F9.4.9x.TMCM./SEC / FSCx 2 3 140,10x, 47HFURE CONCENTRATION AT STOICHIDMETRIC CONDITIONS FSCx 2 4 10x, E13.6 3x, 13HMO, ECULES/CC. FSCx 2 5 140, 10x, 52HFURE CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCx 2 6 5 5, E13.6, 3x, 13HMO, ECULES/CC. FSCx 2 7 140,10x, 40HEQUIVALENCE RATIO AT MAXIMUM FLAME SPEED 16x,F9.5) FSCx 2 1015 FORMAT FSCx 2 1 17x, 43HMUMBER OF CONTRIBUTORS OF MOLECULE OF FUEL) FSCx 2 1 17x, 43HMUMBER OF CONTRIBUTORS FER MOLECULE OF FUEL) FSCx 2 1 17x, 43HMUMBER OF CONTRIBUTORS FER MOLECULE OF FUEL) FSCx 2 1 17x, 14x, 49x, F8.3] FSCx 2 1 1 14x, 20HMUMSPLACED RUN NUMBER 14, FSCx 2 1 14x, 20HMUMSPLACED RUN NUMBER 14, FSCx 2 2 / 140 16x, 22HDF1ION CONTROL INTEGER 14. FSCx 2 2 / 140 16x, 22HDF1ION CONTROL INTEGER 14. FSCx 2 1 101FORMAT FSCx 2 2 / 140 16x, 22HDF1ION CONTROL INTEGER (14) FSCx 2 1 101FORMAT FSCx 2 2 / 140 16x, 22HDF1ION CONTROL INTEGER (14) FSCx 2 1 101FORMAT FSCx 2 7 101F	9 (1HO, 10X, 52HFLAME VELOCITY AT STOICHIGNETRIC CONCENTRATION RATI	FSCX _	275 _ 276
100, 100, 47HFUEL CONCENTRATION AT STOICHIOMÉTRIC CONDITIONS FSCX 2 100, 103, 12HFUEL CONCENTRATION AT STOICHIOMÉTRIC CONDITIONS FSCX 2 100, 103, 52HFUEL CONCENTRATION AT CONDITIONS OF MAXIMUM VELOCIT FSCX 2 FSCX 7 FSC	10 . 3x. F9.4. 9x. 7HCM./SEC /		277 _ 278
103, 248-UEL CUNCENTATION AT CONSTITUES OF PARTICULAR STATE FSCX 2	3 1HO, 10X, 47HFUEL CONCENTRATION AT STOICHIOMETRIC CONDITIONS	FSCX	279 280
1014 FORMAT		FSCX	281 282
1014 FORMAT FORMA		FSCX	283
17X,43HMMBER OF CONTRIBUTORS PER MOLECULE OF FUEL FSCX 2	1014 FORMAT 9 / 1HO. 16X.31HSPECIES CONTRIBUTOR CODE NUMBER .	FSCX	284 285
1	1 17X.43HNUMBER OF CONTRIBUTORS PER MOLECULE OF FUEL)		-286 287
1016 FORMAT 16X,30HDAIA QUI_OF_ORDER - AUN_NUMBER 14.	9 (1H , 27X, 16, 49X, F8-3)	FSCX_	_ 288 289
1 14%, 200HISPLACED RUN NUMBER 14, FSCK 2 2 / 1H0 16%.22HOPTION CONTROL INTEGER 14, FSCK 2 3 22%,21HCONTROL INTEGER CHECK 14) FSCK 2 1017 FORMAT FSCK 2 1019 FORMAT FSCK 2 1019 FORMAT FSCK 2 1019 FORMAT FSCK 2	1016 FORMAT 9 (1HO. 16X.30HDATA DUT OF ORDER - RUN NUMBER 14.	FSCX_	_ 290
3 22X,21HCONTROL INTEGER CHECK 14) F3CX 2 1017 FORMAT F3CX 2 9 (1H1, 25X, 17HEXPERIMENTAL DATA /) F3CX 2 1019 F5RMAT F3CX 2	1 IAY. ZOMNISPLACED RUN NUMBER IT.		291 292
9 (1H1, 25%, 17HEXPERIMENTAL DATA /) FSCX 2	3 22X, 21HCONTROL INTEGER CHECK [4]	FSCX_	293 294
1019 FURNAL TOWNSTONE TENEGRATURE AV. SA. 1. 3V. TMDEC. C. PSCX 2	9 (1H1, 25x, 17HEXPERIMENTAL DATA /)	FSCX	295 296
d (140) 19Y I JANUTAINE JEHACKATOKE 3YA LOSTA 3NA LINES		FSCX	297
1 14% LGHMIXTURE PRESSURE 3X, FG.1, 3X, ILMMM, MERLURY / FSCX 2 2 IND. 16%, SHATOMS OF DXYGEN TO COMPLETELY OXIDIZE ONE MOLECULE FSCX 2	1 14% LGHMIXTURE PRESSURE 3% FG.1. 3% LIMME MERCURY /	FSCX	298 299
30F FUEL 4X, F6.2 / FSCX ON CONCENT IN ONIDANT 3X, F7.4 / FSCX 3	30F FUEL 4X, FG.2 /	FSCX	300 301
5 1HO, 16X, 23HVOLUME PER MOLE OF FUEL 3X, IPEL2, 9, 3X, I (MILE) PER MOLE OF	5 1HO, 16X, 23HVOLUME PER MOLE OF PUEL 3X, I PETZ, 93,3X, I TOLES PER MOLE	FSCX	- 302 303
6M-MOLE) FSCX	6M-MOLE)	FSCX_	304
9 (1H1, 25%, 15HDATA ACCEPTABLE) 1030 FORMAT (1H1, 10%, 23MCOMPUTATIONS COMPLETED)	9 (1H1, 25%, ISHDATA ACCEPTABLE /	FSCX	305
3000 FORMALL IND. 53% STUDAIN CARD ONDER THOUSANDS.	3000 PORMALI IND. 534. STUDATA CARD DEPEN INCOMMEST. CARD HOUSE	FSCX	301
1 14, 5X, 12HRUN NUMBER 15)		FSCX	304

SUBROUTINE EXPOL

EXPERIMENTAL FLAME SPEED DATA REDUCTION CXPOL EXPOL SUBROUTINE MOD 0 MARCH 1, 1962 MRC-DAYTON EXPDI EXPDI EXPDI EXPDI EXPDI NOMENCLATURE CUMULATIVE COME AREA "2/PI TOTAL COME AREA (SOUARE CM.) TOTAL COME AREA (SOUARE CM.) COME DIAMETER AT ABOVE ELEVATION (CM.) MEASURED DIAMETER AT ABOVE ELEVATION INCREMENT SLANT HEIGHT (CM.) REFERENCE LENGTH MEASURED IN UNITS OF DAILY MEFRENCE LENGTH MEASURED IN CM. MOLE FRACTION OF INNIBITOR IN MIXTURE ELEVATION ABOVE BURNER TOP (CM.) MEASURED PEAK HEIGHT OPTION CONTROL INTEGER CHECK MEASURED ELEVATION ABOVE BURNER TOP TOTAL NUMBER OF COME MEASUREMENTS NUMBER OF EXPERIMENTS NUMBER OF DIAMETER MEASUREMENTS PER RUN SIGNAL INTEGER FOR ACCEPTABLE DATA RUN MUMBER OF CATA GROUP RUN NUMBER OF CATA GROUP RUN NUMBER CHECK FOULVALENCE MAITO ATONS OF OXYGEN TO COMPLETELY OXIDIZE OME A(N) D(K) **EXPDI** DA(K) EXPUL EXPDI ELA ELCM FM1(N) H(K) HPKA ICANT EXPOL EXPOL EXPOL EXPOL EXPOL EXPOL EXPOL EXPOL <u>lh(k)</u> Ipk IPN IRK KODE EXPDI NRUN NRUNT O AND O(N) EXPDI - RUN NUMBER CHAITO - ATONS OF DAYGEN TO COMPLETELY OXIDIZE OME MOLECULE OF FUEL - FUEL FLOW (CC./SEC AT VBFD MOLAL YOLUME) - FUEL FLOW OF THIXTURE (CC./SEC AT ACTUAL TEMPERATURE AND PRESSURE) - OXIDANT FLOW (CC./SEC AT O DEG. C, 760 MM. MG) - SCALE FACTOR (CM./UNITS OF DA(K)) - ACTUAL DISTANCE BEINEEN TEETH TIPS SEEN ON SCALE FACTOR (CM./UNITS OF DA(K)) - FLAME SPEED (CN./SEC) - YOLUME PER MOLE OF FUEL (CC./GRAM-MOLE) - VOLUME PER MOLE OF FUEL (CC./GRAM-MOLE) - FUEL FLOW (GRAM-MOLES/SEC.) - DXIDANT FLOW (GRAM-MOLES/SEC.) - MOLE FRACTION OXYGEN IN OXIDENT EXPDI OFSR EXPO1 EXPD1 OFO(N) EXPDI EXPDI QXO(N) EXPOI TEETH U AND U(N) VBFO VBM YOX SUBROUTINE EXPOINRUM. ICTL. OFSR. YOX. VBFO. VBM. IPM. O. U. KODE. TEETH. EXPDI EXPDI 1 MRUNT) COMMON INT_DEC. [C. Jil. J2. J3, NIN, NEX DIMENSION INTIO), DEC(10) DIMENSION A(100), D(100), DA(100), M(100), IM(100), FMI(13) 1 ,0(15), GFO(15), QM(15), QX0(15), U(15) WAITE OUTPUT TAPE 3, 1010 EXPD1 EXPDI EXPOI L = 0 KODE = 3 DU 100 N=1,1PM CALL INPUT NEX = NEX IF(NEX - 4) 200, 11, 200 NUMCON = IC - 4000 IF(NUMCON) 13, 12, 13 EXPO1 54 55 D CARD ASSIGNMENTS EXPOI 4 12 NRUNT = J11 ICANT = INT(1) IRK = INT(2) OFO(N) = DEC(1) EXPOI OXO(N) = DEC(2) FMI(N) = DEC(3) HPKA = DEC(4) ELCM = DEC(5) ELA = DEC(6) GO TO 10 GU 1U 1U IF(NRUNI - JII) 200, 141, 200 LIMIT = 10+ NUNCON IGO = LIMIT - 9 IFI LIMIT - IRK | 142, 142, 140 EXPD EXPDI EXPDI EXPO EXPOL EXPOL TEST FOR MORE THAN ONE HUNDRED MEASUREMENTS. 84 85 EXPOL CALCULATION OF PEAK HEIGHT IN CH. H(IPK) = HPKA + SF D(1PK) = 0.0... JPK1 = 1 PRINTOUT OF FLAME FRONT DIMENSIONS TEST FOR MORE THAN TEN MEASUREMENTS 1F(1PK-10) 24,24,21 00 23 JPK-10,1PK,10 1F(1-48)230,230,231 MRITE OUTPUT TAPE 3. L=0 EXPDI EXPDI EXPD1

EXPERIMENTAL FLAME SPEED DATA REDUCTION		
C . PRINTOUT FOR GROUPS OF TEN MEASUREMENTS	EXPO1	- 107 108
230 WRITE OUTPUT TAPE 3. 10121.	EXPDI	_109
N , (IMIK),K= JPK1, JPK) WRITE <u>Output tape 3, 1013,</u> Y (DA(K),K= JPK1 , JPK)	EXPOL	_ 111 - 112
MRITE OUTPUT TAPE 3. 1014:	EXPDI	_ii3
WRITE OUTPUT TAPE 3, 1015.	EXPDI	_ii5
JPK] =JPK + 1	EXPOL_	_117
23 L= L+ B 24 JRK = PK-1	EXPD1 EXPD1_	118 119
IF(L-48)25,25,241 24L WRITE DUTPUT TAPE 3, 1020	EXPD1	120 121
L=0 C C PRINTOUT FOR LESS THAN TEN MEASUREMENTS	EXPD1	122
C	EXPD1	124
25 MRITE OUTPUT TAPE 3, 10121, 9 N (IH(K) K= JPK1, JRK)	EXPO1	126
WRITE DUTPUT TAPE 3, 1013, 9	EXPO1 EXPO1	128
WRITE OUTPUT TAPE 3, 1014, 9 (M(K) ,K= JPK1 , IPK)	EXPD1	130
WRITE DUTPUT TAPE 3, 1015,	EXPO1	132 133
WRITE OUTPUT TAPE 3, 10151,	EXPOL	134
9. - 1. + 8	EXPO1	135 136
C RUN NUMBER CONSISTENCY CHECK	EXPOL	137 138
C IF (NRUN - NRUNT) 30,31,30	EXPDI_	139 140
30 KODE # 1	EXPOL -	141 142
GO TO 100	EXPDI _	143
C CONTROL INTEGER CHECK	EXPOI	145 146
31 1F (ICTL - ICANT) 30-35-30	EXPDI .	147
CCALCULATION OF OXIDANT AND FUEL FLOW	EXPOL	149
35_WX = QXQ(N)/22414-0	EXPOI_	150 151
WF = QFO(N)/VBFO QM(N) = (WF + MX) + VBM /(1.0 - EMI(N))	EXPDI	152 153
C CALCULATION OF EQUIVALENCE RATIO	EXPDI	154 155
C O(N) = MF=OF5k/12.0+Wx+Y0X)	EXPOLEXPOL _	156 157
[RK =]PK-1	EXPD1	158
C CALCULATION OF COME AREA	EXPO1	. 160
AR = 0.0 DO 40 K=1, IRK	EXPDI EXPDI	162
DELS = SQRTF((H(K+1) - H(K))++2 + ((D(K) - D(K+1))/2.0)++2)	EXPD1_	164
A(N) = 1.570796+AR	EXPDI_	165 166
C CALCULATION OF FLAME SPEED	EXPD1	167
C	EXPD1	169 170
100 CUNTINUE 1F(L+1PM -56) 101-101-102	EXPO1	171 172
L = 0	EXPD1 EXPD1	173
C PRINTOUT OF FLAME SPEED	EXPD1 EXPD1	175 176
C LOI WRITE OUTPUT TAPE 3, 1016	EXPD1 EXPD1	177
OO 110 N=1,1PM A10 WAITE QUIPUT TAPE 3, 1017	EXPD1 EXPD1	179
9 , n, QFO(N), QXO(N), FMI(N), QM(N), A(N), U(N), U(N)	EXPD1 EXPD1	181
NRUNT = IRUNT 120 RETURN	EXPDI EXPOI	183
C DIAGNOSTIC - UNACCEPTABLE CARD ORDER	EXPD1	184 185
200 NEX = 2	EXPDI	186 187
WRITE OUTPUT TAPE 3, 3000, IC, JII KODE = 1	EXPO1	188 189
	EXPOI	190 191
C FORMAT STATEMENTS	EXPDI	_192 193
1010 FORMAT 9 (1HO, 10X, 22MFLAME FRONT DIMENSIONS / 1HO, 4M SET 1	EXPOI	194 195
10121 FORMAT 9 (1MG, 14, 2X, 19MSTATION (MEASURED) ,4X, 1019)	EXPDI	196 197
1013 FORMAT	EXPDI	198 199
1014 FORMAT	EXPD1 _	200
9 (1H , 6X, 14HHEIGHT (CM.) , 9X, 10F 9.5)	EXPDI _	201 202
9 (1H , 6x, 14HD1AMETER (CM.) , 9x, 10F 9.5) .	EXPDIEXPDI	203 204
9 (1H , 6%, 12HSCALE FACTOR 3X, F 10.5)	EXPDI	205
9 (1HU, 4H SET, 7x, 9HEUEL FLOW, 4x, 12HOXIDANT FLOW, 3x, 1 13HOLE FRACTION, 5x, 11HYOLUME FLOW, 7x, 9HCOME AREA, 2 5x, 11HFLAME SPEED, 5x, 11HFQUIVALENCE	EXPOL	207
2 5x, limflame Speed , 5x, limequivalence / 3 im , lix, 9m(cG_/SEC) , 6x, 9m(cG_/SEC) , 6x, 9minhibitor ,	EXPDI	204
3 IM , LIX, 9M(CC./SEC), 6X, 9M(CC./SEC), 6X, 9MINNIBITOR, 6X, 9M(CC./SEC), 8X, 9MICO. CR.), 6X, 9MICM./SEC), 5 9X , 5MRATIO).	EXPOL EXPOL	211
3 44 1 Sukatin (**** * * * * * * * * * * * * * * * *		

SUBROUTINE EXPOL

SUBROUTINE EXPOL	T (NUED)
EXPERIMENTAL FLAME SPEED DATA REDUCTION	
1017 FORMAT	1 EXPD1 213
1017 FORMAT 9 (14 , 14, 6x,F10.5,6x,F10.5,6x,F10.5,6x,F10.5,6x,F10.5,6x	F10.5. EXPD1 214 EXPD1 215
1018 FORMAT	EXPD1 216 EXPD1 217
1020 FORMAT	EXPO1 218 EXPO1 219
3000 FORMATI 1HO, 254, 41MDATA CARD ORDER INCORRECT - CARD NUM	### EXPD1 220 EXPD1 221 EXPD1 222

SUBROUTINE EXPOS

EXPERIMENTAL FLAME SPEED DATA REDUCTION

CEXPD3		OD1 SEPT 8, 1962 MRC DAYTON	EXPO3 EXPO3
C	NOMENCLATURE		EXPO3 EXPO3
<u> </u>		UNULATIVE CONE AREA +2/PI	EXPO3
	D(K) - C	OTAL CONE AREA (SQ. CM.) ONE DIAMETER AT ABOVE ELEVATION (CM.)	EXPD3
Ç	DA(K) - 1	EASURED DIAMETER AT ABOVE ELEVATION NORTHERN SLANT HEIGHT (CM.)	EXPO3
<u> </u>	ELA - F	SFERENCE LENGTH MEASURED IN UNITS OF DACK)	EXPD31
Ç	ELCM - A FMI(N) - A	EFERENCE LENGTH MEASURED IN CH. OLE FRACTION OF INHIBITOR IN MIXTURE	EXPD3 1 EXPD3 1
C	H(K) - E	LEVATION ABOVE BURNER TOP (CM.)	EXPD3 1
.C	ICANT - C	EASURED PEAK HEIGHT PTION CONTROL INTEGER CHECK	EXPO31 EXPO3 1
٤	IH(K) - A	EASURED ELEVATION ABOVE BURNER TOP OTAL NUMBER OF COME MEASUREMENTS	EXPD3 1
ζ	1PN 1	UNBER OF EXPERIMENTS	EXPD31
с С	irk - P	UMBER OF DIAMETER MEASUREMENTS PER RUN OUNTING INTEGERS	EXPD3 1 EXPD3 2
Č	KODE - S	IGNAL INTEGER FOR ACCEPTABLE DATA	EXPO3 2
C	NRUN - F	UN NUMBER OF DATA GROUP UN NUMBER CHECK	EXPD32 EXPD3
.c	O AND OTHER - F	OUTVALENCE MATIO	EXPD32
<u>c</u> .	OFSR - /	TOMS OF DAYGEN TO COMPLETELY OXIDIZE ONE MOLECULE OF FUEL	EXPD32
c	QFO(N) - !	MOLECULE OF FUEL UEL FLOW (CC./SEC AT VBFO MOLAL VOLUME) OLUME FLOW OF MIXTURE (CC./SEC AT ACTUAL	EXPD3 2 EXPO3 2
<u> </u>		TEMPERATURE AND PRESSURE!	EXPD3 2
.ç	QXO(N) - (IXIDANT FLOW (CC-/SEC AT 0 DEG. C. 760 MM. HG) Cale factor (CM-/UNITS OF DA(K))	EXPD33
c	TEETH	CTUAL DISTANCE BETWEEN TEETH TIPS SEEN ON	" EXPO3 3
Ç	U AND U(N) -'I	SCHLIEREN PHOTOGRAPH (CM.) LAME SPEED (CM./SEC)	EXPD3 3 EXPD3 3
ç	VBFO - \	OLUME PER MOLE OF FUEL (CC./GRAM-MOLE)	EXPD3 3
ç	WF - 1	UEL FLOW (GRAM-MOLES/SEC.) .	EXPO3 3
Ç:	.wx	XLOANT FLOW (GRAM-MOLES/SEC.) OLE FRACTION OXYGEN IN OXIDENT	EXPQ33 EXPO3 3
<u> </u>	·		EXPD34
1	SUBROUTINE EXPOSINKUI	I, ICTL, OFSR, YOX, VBFO, VBM, IPN, O, U, KODE, TEETH,	EXPD3 4
(COMMON INT, DEC. IC.	J11. J2. J3, NIN, NEX	EXPD3 4 EXPD3 4
	DIMENSION A(100), D(00), DA(100), H(100), IH(100), FMI(15)	EXPD3 4
	RITE OUTPUT TAPE 3.	(15) • QM(15) • QXQ(15) • U(15)	EXPO3 4
(L=0		4 EXPD3 4
	KODE = 3 DO 100 N=1,1PN		EXPO3 4
10	CALL INPUT		EXPD3 5
	NEX = NEX IF(NEX - 4) 200, 11,	200	EXPO35
- 11 '	NUMCON = IC - 4000 IF(NUMCON) 13, 12,		EXPD3 5
<u></u>		13	EXPD35
•	D CARD ASSIGNMENTS	•	EXPO3 5 EXPD3 5
12	WRUNT - JLI	,	EXPD3 5
	NRUNT = JLI ICANT = INT(1) IRK = INT(2)		EXPO3 6
	UFO(N) = DEC(1)		EXPD3 6
	DXO(N) = DEG(2) FMI(N) = DEG(3)		EXPD3 6
- 1	HPKA = DEC(4) ELCM = DEC(5)		EXPD3. 6
	ELA = DEC(6)		EXPO3 6
13	GO TO 10 IF(NRUNT - J11) 200,	141, 200	EXPD3 6
141_	LIMIT = 10+ NUMCON		EXPD37
	IGO = LIMIT - 9 IF(LIMIT - IK <u>k) 1</u> 4	2, 142, 140	EXPD3 7
140	LIMIT = IRK M = 0	,	EXPO3 7 EXPO3 7
	00 143 K = 160, LIMI		EXPD3 7
	M = M + 1 H(K) = INT(M)		EXPO3 7 EXPO3 7
143	DA(K) = DEC(M)	144 14	EXPD3 7
144_	IF(LIMIT - IRK) 10. Ikum =nrum + m -1	1976 10	EXPD38
	[F1]EEIM]14.12.14		EXPD3 8
14	TEETH =0.2 SF = ELCH /ELA		EXPD3 8
έ	IPK = <u>IRK + 1</u>		EXPO3 8
<u> </u>	TEST FOR HORE THAN	DNE HUNDRED MEASUREMENTS	EXPO3 6
C	IF([PK=100] 19, 19, 30_		EXPD3 8
19	00 20 K= 1 , IRK H(K) = TEETH =FLOATF	TH(K)-11	EXPD3 8
20	DIK) = DAIK)+SF	3,018/-1/	EXPO3 9
	CALCULATION OF PEAK	HEIGHT IN CH.	EXPD3 9
C			EXPD3 9
	H(1PK) = HPKA + SF D(1PK) = 0.0		EXPU3 9
	JPK1 = 1 .		EXPD3 9
<u>-</u>	PRINTOUT OF FLAME FO	CONT DIMENSIONS	P FORKS
è	TEST FOR MORE THAN	TEN MEASUREMENTS	EXPD3 10
C			EXPD3 10
	[F(]PK-10] 24,24,21 DO_23_JPK=10_[PK_10_		EXPD3 10
	IF(L-48)230,230,231		EXPD3 10

EXPERIMENTAL FLAME SPEED DATA REDUCTION EXPOS EXPOS EXPOS EXPOS EXPOS EXPOS EXPOS EXPOS EXPOS L=0 PRINTOUT FOR GROUPS OF TEN MEASUREMENTS 24 IF(L-48)25.25.241 241 WRITE DUTPUT TAPE 3, 1020 L=0 PRINTOUT FOR LESS THAN TEN MEASUREMENTS EXPD3 EXPU3 25 NRITE OUTPUT TAPE 3, 1012. 9 IRUN, HPKRA, (IM(K), K= JPK1, IRK) WRITE OUTPUT TAPE 3, 1013. 9 (DA(K), K= JPK1, IRK) WRITE OUTPUT TAPE 3, 1014. 9 HRITE OUTPUT TAPE 3, 1014. | MIKE, K= JPKE, IPKE, I RUN NUMBER CONSISTENCY CHECK IF (1RUN - NRUN1) 30,31,30 IRUNT = NF NRUNT ____ EXPD3 CUNTROL INTEGER CHECK 31 IF (1CTL - ICANT) 30,35,30 EXPO3 C ... CALCULATION OF OXIDANT AND FUEL FLOW 35 WX = 0X0(N)/22414.0 CALCULATION OF EQUIVALENCE RATIO D(N) = WF+OFSR/(2.0+WX+YOX) CALCULATION OF CONE AREA EXPD3 EXPD3 DD 40 K = 1, IRK DELS = SQNTF([H(K+1) - H(K)]**2 + ([D(K) - D(K*1)]/2,0)**2} AR = AR + (D(K) + D(K*1)]**DELS A(N) = 1,570796*AR EXPD3 EXPD3 CALCULATION OF FLAME SPEED U(N) = QM(N)/A(N) 100 CONTINUE 1F(L+IPN -56) 101,101,102 102 WRITE OUTPUT TAPE 3, 1018 PRINTOUT OF FLAME SPEED 101 WRITE OUTPUT TAPE 3, 1016 00 110 N=1,1PN IRUN = NRUN -1 +N 110 WRITE DUTPUT TAPE 3, 1017, 9 IRUN, <u>OFO(M), OXO(M), FMJ(M), OM(M), A(M), U(M), D(M)</u> NRUNT = IRUNT 120 RETURN DIAGNOSTIC - UNACCEPTABLE CARD DADER 200 NEX = 2 WRITE OUTPUT TAPE 3, 3000, IC, J11 FORMAT STATEMENTS 1010 FORMAT TOTO FURNAT 9 (1HG, 10x, 22MFLAME FRONT DIMENSIONS /1HG, 4M RUN) 1012 FORMAT EXPD3 EXPD3 9 (1HO, 14, 2X, 28HPEAK HEIGHT (MEASURED UNITS) F8.2 / 1 1H, 6X, 19HSTATION (MEASURED), 4X, 1019) EXPD3 1015 FORMAT 9 (1M . 6X, 14MHEIGHT (CM.) , 1015 FORMAT 9 (1M , 6X, 14MDIAMETER (CM.) , 10151 FORMAT 9X, 10F 9.5) EXPOS EXPOS EXPOS 4x, 10F 9.5 1 9 (1M , 6X, 26HACTUAL LENGTH OF REFERENCE 3X,F10.5,3X, 3HCM. J. JK. 28HHEASURED LENGTH OF REFERENCE 3X,F10.5,3H UNITS) 1016 FURNAT 9 (1HO, 4H RUN, 7X, YHFUEL FLOW, 4X, 12HOXIDANT FLOW, 1 3X.

SUBROUTINE EXPOS

. (CONTINUED)

EXPERIMENTAL FLAME SPEED DATA REDUCTION

The second of th		
1 13HHOLE FRACTION , SK. 11HVOLUME FLOW , TX, SHCONE AREA . 3	EXPO3	213
2 5X, 11HFLAME SPEED , 5X, 11HEQUIVALENCE /	EXPD3	214
3 IH . LIX, SHICC./SEC). 6X, SHICC./SEC) . 6X, SHINHIBITOR	EXPO3	215
4 8x , 9H(C./SEC), 8x, 9H(SQ. CH.) , 6x, 9H(CH./SEC) ,	EXPD3	716
5 9x , SHRAFIO 1	EXPD3	217
1017 FORMAT	EXPD3	218
9 (1H , [4, 6X,F10.5,6X,F10.5,6X,F10.5,6X,F10.5,6X,F10.5,6X,F10.5,6X,F10.5,6X	EXPD3	219
1 6X.F10.51	EXPD3	220
1018 FORMAT	EXPU3	221
9 (1111)	EXPD3	222
1020 FORNAT	EXPD3	223
9 (1H1, 1OK, 22MFLAME FRONT DIMENSIONS /LHO , 4H RUN')	EXPO3	224
3000 FORMATE THO, 25X, ALMONTA CARD DRDER INCORRECT - CARD MUMBER	EXPD3	225
1 14, 5x, 12HRUN NUMBER 15)	EXPD3	226
ENG	FXPD3	227

SURBDUTTINE MAYN

MAXIMUM FLAME SPEED DETERMINATION

	SUBROUTINE MAXM FOR ROUTINE 2019 FEB 20 1962 MRC - DAYTON NOMENCLATURE	MKAM MKAM MKAM	
	A(K) - COEFFICIENTS OF FITTED EQUATION	MXAM	
_	A(K) - COEFFICIENTS OF FITTED EQUATION ARG - ARGUMENT OF QUADRATIC SQUARE ROOT	MAXM MAXM	
	G(J,K) — SUM OF SQUARES AND CROSS PRODUCTS OF THE	MAXM	
	X(N,K) MATRIX	MAXM	
	J. K. L. N - INDICIES	MXAM MXAM	
	K9 - SIGNAL FLAG FOR SEQUENCE OF CALCULATIONS	MAXM	
	KODE - SIGNAL INTEGER FOR ACCEPTABLE DATA MAXON - SWITCH TO BYPASS MAXM SUBROUTINE	MAAM	
	MAXON - SWITCH TO BYPASS MAXM SUBROUTINE (ANY NON-ZERO VALUE BYPASSES SUBROUTINE)	MXAM MXAM	
	NCF - NUMBER OF COEFFICIENTS	MAXM	
	O(N) - EQUIVALENCE RATIO OH - LARGEST EQUIVALENCE RATIO IN SET	MAXH	
	OINF - EQUIVALENCE RATIO AT INFLECTION POINT OF CUBIC	MXAM	
	CURVE	MAKM	
	OL - SMALLEST EQUIVALENCE RATIO IN SET OMX - EQUIVALENCE RATIO AT MAXIMUM FLAME VELOCITY	MAXH	
	SIDS - MAXIMUM ALLOWABLE STANDARD DEVIATION OF U VS	MAXM	
	U CURVE FOR ADDITION TO TAPE	MAXM	
	SUM - SUN OF THE SQUARES OF THE DEVIATIONS U(N) - FLAME SPEED (CM-/SEC)	HXAH	
	U(N) - FLAME SPEED (CM./SEC) - DEVIATION BETWEEN MEASURED AND PREDICTED	MXAM MXAM	
	FLAME SPEED (CM./SEC)	MXAM	•
	UDP(N) - PERCENT DEVIATION BETWEEN MEASURED AND	MAXH	
	PREDICTED FLAME SPEED UMX — MAXIMUM FLAME SPEED (CM-/SEC)	MAXM	
	UP(N) - PREDICTED FLAME SPEED (CM./SEG)	MXAM	
	. USTOSTANDARD DEVIATION OF FLAME SPEED (CH./SEC)	MAXM-	
	USTOC - FLAME SPEED AT STOICHIMETRIC CONDITIONS (CM./SEC)	MAXM MAXM	
	X(N,K) - INDEPENDENT VARIABLES	MAXM	_
	SUBROUTINE MAXME IPN. O. U. ONX. UNX. USTOC. KODE. STDS.	MAXM	
1	COMMON INT. DEC. IC. J11. J2. J3. NIN. NEX	MXAM MXAM	
» «· ••	DIMENSION INT(10), DEC(10)	MAXM	••
	PIMENSION ACIO: GC10-111-0(10)-U(10)-UD(10)-UDP(10)-UP(10)-X(10-11	MXM	_
	KODE = 0	MXAM MXAM	
	IF(MAXON) 500, 20, 500	MXAM	٠
20_	WRITE OUTPUT TAPE 3, 1001	MAXM	
25	IF (IPN - 2) 500,500,25 OL - O(1)	MXAM	
	OH = OL	MAXM	-
	00 30 N=1,IPN	MAXM	
	$OL = MINIF(OL_{1}O(N))$ $OH = MAXIF(OH_{1}O(N))$	MXAM	
		MAAM	
	FORMATION OF COCFFICIENT MATRIX	MAXM	
	X(No.1) = 1.00	MAXM	
•	x(n,2) = O(n)	MXAM	
	X(N,3) = O(N)++2 X(N,4) = O(N)++3	MAXH	_
_30	x(n,5) = U(n)	MAXM MAXM	
		MXAM	_
	TEST FOR HORE THAN FOUR DATA POINTS	MAXM	
	IF (IPN - 4) 150,40,50	MAXM	
		HAXH	
	ATTEMPT TO FIT FOUR DATA POINTS TO A FOUR CONSTANT EQUATION	MAXM MAXH	-
	SOLUTION OF FOUR EQUATIONS IN FOUR UNKNOWNS	MAXM	
		MAXM	•
40	CALL CROUT (4.X.A)	<u>#AX#</u>	-
	TEST FOR UNSUCCESSFUL SOLUTION	MXAM MXAM	
		MAXM	_
	IF (SENSE LIGHT 3) 41. 70	MXM	
_	PRINTOUT OF UNSUCCESSFUL FIT	MAXM. MAXM	
		MAXM	_
41.	WRITE OUTPUT TARE 3. 1010	MAXM	
	WRITE OUTPUT TAPE 3, 1011, ((X(K,t),t=1,5),K=1,4)	MAXM MAXM	
	GO TO 200	MAXM	-
	ATTEMPT TO FIT FOUR OR MORE DATA POINTS TO A FOUR CONSTANT	MAXM	_
	EQUATION	MAXH	
		MAXM	
_50.	00 60 J=1,4 00 60 K=1,5	_ MXAM	
	G(J, K) = 0.0	MAXM	
	DO 60 N=1, IPN	MAXM	
	GENERATION OF FOUR REGRESSION EQUATIONS	MAXH	
	·	MAXM	
60	G(J,K) = G(J,K) + aX(N,J) + X(N,K)	HXAM	
	SOLUTION OF FOUR REGRESSION EQUATIONS IN FOUR UNKNOWNS	MAXM	-
		MXAM	
	CALL CROUT (4.G.A)	MAXM	
	IFI SENSE LIGHT 3) 61. 70	MAXM	
	PRINTOUT OF UNSUCCESSFUL FIT	MAXM MAXM	_
		MAXM	_
61	WRITE OUTPUT TAPE 3, 1010	MXAM	1
	WRITE OUTPUT TAPE 3, 1011, ((G(K-L)-L=1-5-)-K=1-5)	MAXM MXAM	1
1	60 10 200	MAXM	
,			1 1 1

SUBROUT	INE MAXM	

(CONTINUED)

MAXIMUM FLAME SPEED DETERMENATION		
70 NCF + 4,	HXAM	107
KO = 1 IF DIVIDE CHECK 71, 71	MAXH	109
71 UMX = 0.0 OMX = 0.0	MAXM	110
OINF = ~A(3)/(3.00A(4))	MAXM	112
1F DIVIDE CHECK 310, 75	HXAM MXAM	-113 114
ARG = 1.0 - 3.004(2)+8(4)/A(3)++2 IF DIVIDE CHECK 310, 80	MAXM	-115 116
	MAXM	117
C TEST FOR SQUARE ROOT OF NEGATIVE NUMBER	MAXM MXAM	118
#0 IF (ARG) 310,310,85	MXAM MXAM	120 _121
- 85 K9 - 3	MKAN	122
C PETERMINATION OF EQUIVALENCE RATIO AT MAXIMUM FLAME SPEED	MXAM MXAM	-123 124
ONY - CINEALL C A SIGNELECOTELANCELALALALALA	MXAM	. 125 126
C TEST TO SEE IF EQUIVALENCE RATIO AT MAXIMUM FLAME SPEED IS WITHIN C DATA RANGE	MAXM	_127.
C DATA RANGE	MXAM MXAM	128
IF (QMX - DM) 90,90,300	MXAMMXAM	130
90 IF (OL - OMX) 95,95,300	MAXM	132
ONIN = DINF + (1.0 - SIGNF(SORTFIARG),A(3)))	MXAM	_133, 134
C TEST FOR MINIMUM POINT IN DATA BANGE	MXAM	135
IF (OMIN - OH) 100 110 110	MAXH	137
100 IF(OL - OMIN) 300,110,110 110 K9 - 7	MAXM	138
GO TO 300	HXAM	140
C END OF OPERATION ON CUBIC FIT	MAXM	142
C ATTEMPT TO FIT THREE DATA POINTS TO A THREE CONSTANT EQUATION	MAXM .	143
150 00 160 N=1,1PN	MXAM	_145 146
160 X(N;4) = U(N)	. MAXH _	147
CALL CROUT (3,X,A) IF(SENSE LIGHT 31 161, 230	MXAM	148
6	MXAMMXAM	150 151
C PRINTOUT OF UNSUGCESSFUL FIT	MAXM	152
161 WRITE OUTPUT TAPE 3, 1012, WRITE OUTPUT TAPE 3, 1013,	. MAXM Maxm	153
9 ((X(K ₀ L) ₂ L=1 ₂ 4) ₄ K=1 ₂ 3) GO TO 500	MXAM MXAM	155 156
C	MAXH	,157
C ATTEMPT TO PIT FOUR OR MORE DATA POINTS TO A THREE CONSTANT	MXAM MXAM	158
C	MXAM	160
200 00 210 N=1, IPN 210 X(N,4) = U(N)	MXAM	161
DO 220 J=1,3 DU 220 K=1,4	MXAM	163
G(J,K) = 0.0 D0_220_N=1,IPN	MAXM	165 166
C	MAXM	167
C GENERATION OF THREE REGRESSION EQUATIONS C	MXAM	-168 169
$\frac{220 \text{ G(J,K)} = \text{G(J,K)} + \text{X(N,J)} + \text{X(N,K)}}{c}$	MXAM	-170 171
C SOLUTION OF THREE EQUATIONS IN THREE UNKNOWNS	MXAM	-172 173
CALL CROUT (3.G.A)	MAXM	174
C TEST FOR UNSUCCESSFUL SOLUTION	MXAM	175
C in the second of the second	MXAM	177
FISENSE LIGHT 3) 221, 230 C C PRINTOUT OF UNSUCCESSFUL FIT	MAXM-	179
•	HXAM	_181 _181
221 WRITE OUTPUT TAPE 3, 1012, WRITE OUTPUT TAPE 3, 1013,	MXAM	182 183
9 ((G(K,L),L=1,4),K=1,3)	MXAM	184
GO TO 500	MXAM	_185 _186_
C OPERATIONS ON THREE OR MORE DATA POINTS	MXAM	188
230 NCF = 3	MXAM	189
K9 e 5 A14) = 0.0	MAXM	191
UMX = 0.0	MXAM MXAM	_192
IF (A(3)) 240,310,310	MXAM	194
240 K9 = 6 C	MAXM .	146
C DETERMINATION OF EQUIVALENCE RATIO AT MAXIMUM PLAME SPEED	MAXM MAXM	197 _198
OMX = -A(2)/(2.0*A(3))	MAXM MAXM	199
C TEST TO SEE IF EQUIVALENCE RATIO AT MAXIMUM FLAME SPEED IS MITHIN	MXAM	201
C DATA RANGE	MAXM	202 203
1F (QMX - DH) 250.250.300	MXAM	204
250 IF (OL - OMX) 260,260,300 C	MAXM	206
C END OF OPERATION ON PARABOLIC FIT C OPERATION ON DATA AFTER SUCCESSFUL FIT	MXAM MXAM	20 <i>1</i> 208
	MXAM MXAM	209
260 K9 • 7	MARM	211
Company and the second	MAXM	212

				1-4-6		
SI	JB.	ROI	JTI	NE	MA	XM

MAXIMUM FLAME SPEED DETERMINATION 1013 FORMAT 9 (1H , 1014 FORMAT 9 (1H0, 1016 FORMAT 9 (1H , 1017 FORMAT 9 (1H0, MXAM MXAM MXAM MXAM MXAM 10x, E12.5, 10x, E12.5,10x, E12.5,10x, E12.5) 10X, 22HFLAME SPEED CURVE DATA 3 6x, 4(4x, 1PE12.4), 5x, 0PF8.4 , 8x,F9.5, 9x,F9.4) 1017 FORMAT

9 (1HO, 10x, 8HDATA SET, 10x, 11HEQUIVALENCE 10X, 8HMEASURED

1 11x, 9HPREDICTED 10x, 9HOEVIATION 11X, 7HPERCENT /

2 1H 31x, 5HAATIO 12x, 11HFLAME SPEED 8x, 11HFLAME SPEED

10171 FORMAT

9 (1HO, 10x, 8H NUM, 10x, 11HEQUIVALENCE 10x, 8HMEASURED 1 11x, 9HPREDICTED 10x, 9HUEVIATION 11x, 7HPERCENT /

2 1H 31x, 5HBATIO 12x, 11HFLAME SPEED 8x, 11HFLAME SPEED

1018 FORMAT MAXM 3 28X, 9HOEVIATION /)

1018 FORMAT

10X, 18, 10X, F11.4, 10X, F9.4, 10X, F9.4, 10X, F9.4, 10X, F9.4)

1019 FORMAT 1019 FORMAT
9 (1NO, 10x, 35HCUBIC FIT OF CURVE UNSATISFACTORY -)
1020 FORMAS 9 (1M+, 47x, 23HPARABOLIC FIT INDICATED I 9 (1M+, 47x, 16MMO MAXIMUM FOUND) MXAM MXAM MXAM AUGZ FORMAT 9 (1H+, 47X, 26HMAXIMUM DUTSIDE DATA RANGE)
103 FORMAT 9 (1H+, 47X, 27HMINITUM) MAXM 345 MAXM 346 MAXM 347 MAXM 349 MAXM 350 MAXM 351 MAXM 352 MAXM 353 MAXM 353 MAXM 355 MAXM 355 MAXM 355 MAXM 357 MAXM 357 MAXM 361 1623 FORMA!
9 (1H++, 47x, 27HHINIHUM POINT IN DATA HANGE)
-1024 FORMAT.
9 (1H++) 6x, 39HPARABOLIC FIT OF CURVE UNSATISFACTORY -)

(CONTINUED)

MASIER LIBRARY TAPE MODIFICATION

C ADIENCLATURE (ACCLI,18) AND 2211 - FUEL MANE C ACCLI,18) AND 2211 - FOR 1211 -	TAPE 1 APPLE MANE	CTAPE	SUBROUTINE TAPE FOR ROUTINE 2018 MARCH 5, 1962 MAC - DAYTON	TAPE	ı
ACCLIA, N. — NAMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE ACCLIA, N. — NAMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE ACRELIA, — CONTRIBUTOR SERVIS FROM CARDS. LIKK — DELAWARY OF STRUCTURAL CONTRIBUTORS PER MOLECULE ACREMICAL OCCUPATION OF STRUCTURAL CONTRIBUTORS PER MOLECULE ACREMICAN OF STRUCTURAL CONTRIBUTORS CONSIDERED ACREMICAN OF STRUCTURAL CONTRI	0 AZII		NOMENCLATURE		3
C AGMLIA! — CONTENSION TO ANALYSE AND AND ANALYSE AND AND ANALYSE AND ANALYSE AND ANALYSE ANALYSE AND ANALYSE	APPLIED	C		TAPE	
C AGNELIK.	- NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 9 - BLANK LUSSO LOCKPRIBUTORS PER MOLECULE TAPE 10 - OPECIMAL DATA STONAGE MANE LIST TAPE 11 - OPECIMAL DATA STONAGE MANE LIST TAPE 12 - OPECIMAL DATA STONAGE MANE LIST TAPE 13 - TAPE 14 - FURCHERS OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 14 - FURCHERS OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 14 - FURCHERS OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 14 - FURCHERS OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 14 - LOCK SECOND MALVES OF FURL MARE TAPE 10 - LOCK SECOND MALVES OF FURL MARE TAPE 10 - FUEL CLASS NUMBER TAPE 12 - FUEL MANEER TAPE 12 - FUEL MANEER TAPE 12 - FUEL MANUER TAPE 13 -		ACCLIL,K) - NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE 1M REVISED LIST	TAPE	
S. S. S. S. S. S. S. S.	- BLANK (USED IN CONTRIBUTOR MARK LIST TAPE 10 - OPCINAL DATA STOKAGE TAPE 17 - OPCINAL DATA STOKAGE TAPE 17 - OPCINAL DATA STOKAGE TAPE 17 - DEPENDENT VARIABLE MANE LIST TAPE 17 - FUR CONTRIBUTOR NUMBER LEGCCHIK) TAPE 14 - FUR CONTRIBUTOR NUMBER LEGCCHIK) TAPE 16 - NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 16 - NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 16 - NUMBER OF STRUCTURAL CONTRIBUTORS PER MOLECULE TAPE 16 - FURL GOOK MARE FROM TAPE TAPE 17 - FURL CLASS NUMBER TAPE 17 - FURL GROUP NUMBER TAPE 17 - FURL GROUP NUMBER TAPE 18 - FURL HERBER MUNBER TAPE 20 - FURL HERBER MUNBER TAPE 22 - FURL HERBER MUNBER TAPE 22 - OPTION CONTROL INTEGER, CRIECK TAPE 23 - OPTION CONTROL INTEGER, CRIECK TAPE 24 - OPTION CONTROL INTEGER, CRIECK TAPE 24 - OPTION CONTROL INTEGER, CRIECK TAPE 24 - FURL HERBER MUNBER TAPE 24 - FURL HERBER MUNBER TAPE 25 - OPTION CONTROL INTEGER, CRIECK TAPE 29 - FURL HERBER MUNBER TAPE 29 - FURL HERBER MUNBER	С	AGNLIK) - CONTRIBUTOR NAMES (FROM CAROS)		
DOMNIK) — ODEPROCENT VARIABLE NAME LIST	DIE FIRST AND SECONO ILALVES OF DATE	<u>_c</u>	BLK - BLANK (USEO IN CONTRIBUTOR NAME LIST)	TAPE1	Ó
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19FGC	SIX PER -H - CARD TAPE	С	(REMAINDER OF -G- CARD)		
IPFM	FOLLOWING ON TAPE - NUMBER OF CARDS SOLLOWING MITH CONTRIBUTOR - NUMBER OF CARDS SOLLOWING MITH CONTRIBUTOR - NUMBER, OF CARDS SON TAPE 2 BEFORE ADDITIONS - NUMBER, OF GROUPS ON TAPE 2 AFFER ADDITIONS - DATA GROUPS SEKIAL NUMBER (FROM TAPE 2) - CODE INTEGER FOR INITIAL TAPE PREPARATION - SPECIES CONTRIBUTOR CODE NUMBER - CONTRIBUTOR CODE NUMBER - CONTRIBUTOR CODE MUMBER - CONTRIBUTOR CODE MOMBER - CONTRIBUTOR CO		(SIX PER -H- CARD)		
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Ji(K,1)	- SPECIES CONTRIBUTOR CODE NUMBER - CONTRIBUTOR CODE NUMBER - CONTRIBUTOR CODE NUMBER - NUMBER OF STRUCTURAL CONTRIBUTORS, CONSIDERED TAPE - CONTRIBUTOR CUDE NUMBER (FROM CAROS) TAPE - CONTRIBUTOR CUDE NUMBER (FROM CAROS) TAPE - DATA GROUP SERIAL NUMBER (FROM CAROS) TAPE - OATA GROUP SERIAL NUMBER (FROM CAROS) - COUNTING INTEGER FOR LIMES PRINTED PER PAGE - RUN NUMBER OF CONTRIBUTOR COUNT CHANGES, FOR DATA - COUNTING INTEGER FOR LIMES PRINTED PER PAGE - RUN NUMBER CHECK - RUN NUMBER	į	ISFN DATA GROUP: SERIAL NUMBER_(FROM TAPE 2)	TAPE4	6
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LFMILL	- DATA GROUP SERIAL NUMBER (FROM CARCS) 1 - NUMBER OF CONTRIBUTOR COUNT CHANGES, FOR DATA GROUP SERIAL NUMBER LFRMIL) - COUNTING INTEGER FOR LINES PRINTED PER PAGE - RUN MUMBER OF DATA GROUP - RUN NUMBER CHECK RE TAPE (NRUN, ICTL, AL), AZ, 11A, 11B, 11C, 12, 13, DA, 14, J1, B1, TAPE 58 NE TAPE (NRUN, ICTL, AL), AZ, 11A, 11B, 11C, 12, 13, DA, 14, J1, B1, TAPE 59 NT, DEC, IC, Jil, JZ, J3, NIN, NEX N INTI(D), DEC(10) N A1(201, AZ(120), BI(100, 20), DA 16, Z0), IE(20),		LACNILAK) — CONTRIBUTOR CODE NUMBER (FROM CARDS)	TAPE 5	1
GROUP SERIAL NUMBER LEMMIL: TA	GROUP SERIAL NUMBER LEMMIL) TAPE 55 -COUNTING INTEGER FOR LINES PRINTED PER PAGE TAPE 56 -RUN MUMBER OF DATA GROUP TAPE 57 -RUN NUMBER CHECK TAPE 58 NE TAPE (NRUN, ICTL, ALI, AZ, 11 A, 11 B, 11 C, 12, 13, DA, 14, J1, B1, TAPE 59 NE TAPE (NRUN, ICTL, ALI, AZ, 11 A, 11 B, 11 C, 12, 13, DA, 14, J1, B1, TAPE 59 NE TAPE (NRUN, ICTL, ALI, AZ, 11 A, 11 B, 11 C, 12, 13, DA, 14, J1, B1, TAPE 59 NE TAPE (NRUN, ICTL, ALI, AZ, 11 A, 11 B, 11 C, 12, 13, DA, 14, J1, B1, TAPE 59 NE TAPE (NRUN, ICTL, ALI, AZ, 11 A, 11 B, 11 C, 12, 13, DA, 14, J1, B1, TAPE 60 NI, MINT(10), OEC(1.0) NECO, ICC, J11, J2, J3, NIN, NEX TAPE 62 NI, MINT(10), ACCL (20, 40), AGA, MINT, AGA, MI		LEMN(L) — DATA GROUP SERIAL NUMBER (FROM CARDS)	TAPE 5	.3
C NRUN - RUN NUMBER OF DATA GROUP NRUNT - RUN NUMBER OF DATA GROUP 1 1000, DU, FE, LAST) COMMON NT, DEC, IC, JII, J2, J3, NIN, NEX DIMENSION INT(101, DEC) DIMENSION AL(20), ACCL(20, 90], ACN, 20), 11(20), 12(20), 19(20) 1 1,14(20), 11(100, 20), ACCL(20, 90], ACN, 120), 10(5), DNN(6), FGCL(90), TA 2 FGC.1(200), GNL(200), JGNL(50), LACN(20, 90), LFMN(20), LFGCCN(90), TA 3 LIPACC(20), 11A(20), 11B(20), 11C(20) M * 4 MRITE QUIPUT TAPE 3, 3000, TA MRITE QUIPUT TAPE 3, 3001, TA REMIND 6 10 CALL INPUT NEX = NEX IF (NEX = 0 600, 11, 33 C F CARD ASSIGNMENTS 11 NRUNT = JII ICANI - JNI(1) IPPM = INI(2) IPPM = INI(3) IPP = INI(4) C C OPTION CONTROL INTEGER CHECK TA C 12 IF (ITP + 7) 25, 28, 25 TA C 22 IF (ITP + 7) 25, 28, 25 TA 25 IF (IPPM) 24, 26, 28, 25 TA C 22 IF (ITP + 7) 25, 28, 25 TA C 25 IF (ITPM) 24, 26, 28, 25	- RUN MUMBER OF DATA GROUP - RUN MUMBER CHECK TAPE (NRUN, ICTL, A1, A2, 11A, 11B, 11C, 12, 13, DA, 14, J1, B1, TAPE 58 NE TAPE (NRUN, ICTL, A1, A2, 11A, 11B, 11C, 12, 13, DA, 14, J1, B1, TAPE 59 NT, UEC, IC, Jil, J2, J3, NIN, NEX N A1(201, A2(20), B1(100, 20), DA 16, 20), 11(20), 12(20), 13(20) TAPE 62 N A1(201, A2(120), B1(100, 20), DA 16, 20), 11(20), 12(20), 13(20) TAPE 63 NA(1201, A2(120), AC(120, 40), AG(N, 150), D(16), DMM(6), FGC(190), TAPE 64 DO), GNN((200), JGNN(150), LACN(20, 90), LFMN(20), LFGCGN(90), TAPE 65 O), 11A(20), 11B(20), 11C(20) TAPE 67 1APE 67 1APE 67 1APE 70 DU, TE TAPE 3, 3000, TAPE 68 DU, TE TAPE 70 NRUN TAPE 71 NRUN TAPE 71 ASSIGNMENTS TAPE 72 ASSIGNMENTS TAPE 73 ASSIGNMENTS TAPE 74 ASSIGNMENTS TAPE 74 NRUN TAPE 74 ASSIGNMENTS TAPE 76 ASSIGNMENTS TAPE 76 ASSIGNMENTS TAPE 76 NRU(1) TAPE 80 TAPE 80 TAPE 81 TAPE 81 TAPE 81 TAPE 82 TAPE 83 TAPE 84 TAPE 84 TAPE 86 TAPE 87 TAPE 87 TAPE 90 TAPE 90	•	GROUP SERIAL NUMBER LEMN(L)	TAPE 5	55
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1 1141201, J11100, 201, ACCL 120, 901, AGNL 1501, DNA(5); FGCL 1901). 2 FGC J1(200), GNA(1200), J101(201), TA 3 LIPACC(201, 11A(20), 11B(20), 11C(20) M = 4 MRITE QUIPUT IAPE 3, 3000. 9 NRUN	J11100,201,ACCL(20,901,AGNL(501,016),DMM(6),FGCL(901),		COMMON INT, DEC, IC, J11, J2, J3, NIN, NEX DIMENSION INT(10), DEC(10)	TAPE6	52
2 FGC.J.(2001,GM.(2000), JGM.(1501), LACMIZO, 901,LFAM(201), LFGCCN(901), 3 LIPACC(201), I1A(201), I1B(201), I1C(20) M = 4 MRITE OUTPUT TAPE 3, 3000, MRITE OUTPUT TAPE 3, 3001, NRUN AREWIND 6 10 CALL INPUT NEX = NEX IF (NEX = 6) 600, 11, 33 C F CARD ASSIGNMENTS TA C II NRUNT = JII ICAN1 = JNT(1) IPPH = INT(2) IPPH = INT(2) IPP = INT(4) LAST = JNT(4) C C RUM MUMBER COMSISIENCY CHECK TA C OPTION CONTROL INTEGER CHECK TA C 21 IF (IPTH > 29,21,29 TA C C TESTS FOR EXECUTABLE CONDITIONS TA C 22 IF (IPPH) 26,26,325 TA C TA TA TA TA TA TA TA TA	DOI, GNL (200), JGNL (50), LECKIN (20, 90), LFMN (20), LFGCCN (90), TAPE 62, 20), TIAL(20), TIC (20) TAPE 66, TAPE 67, TAPE 68, DU, TE TAPE 68, DU, TE TAPE 68, TAPE 69, TAPE 69, TAPE 69, TAPE 70, TAPE 71, TAPE 71, TAPE 71, TAPE 71, TAPE 71, TAPE 72, TAPE 73, 3001, TAPE 74,	1	DIMENSIUN AI(20),A2(20),B1(100,20),DA(6,20),[1(20),[2(20),[3(20), ,4(20),1)(100,20),ACCL(20,90),AGNL(50),D(6),DNM(6),FGCL(90),		
MRITE QUIPUT IAPE 3, 30QU,	FPUT TAPE 3, 300U	ž	FGCJL(200),GNL(200),JGNL(50),LACN(20,901,LFMN(20), LFGCCN(90) ,	TAPE 6	55
9	DUTE TAPE 67 PUT TAPE 3, 3001, TAPE 71 NRUN TAPE 77 INFO TAPE 77 TAPE 78 TAPE 80 TAPE 90 TAPE 91 TAPE 91 TAPE 92 TAPE 91 TAPE 101		M = 4	TAPE 6	7
#RITE OUTPUT TAPE, 3, 3001, REWIND 6 10 CALL INPUT NEX = NEX 11 IF (NEX - 6) 600, 11, 33 C F CARD ASSIGNMENTS 11 INRUNT = JII 12 16AN1 = INI(1) 13 17 18 18 18 14 19 18 18 15 19 18 18 16 19 18 18 17 19 18 18 19 18 18 19 18 18 10 18 18 11 19 18 12 19 18 13 19 18 14 19 18 15 19 18 16 19 18 17 18 18 18 19 18 19 19 18 10 18 18 11 18 18 12 18 18 18 13 18 18 14 18 18 15 18 18 16 18 18 17 18 18 18 18 18 19 18 18 10 18 18 11 18 18 12 18 18 18 13 18 18 14 18 15 18 18 16 18 17 18 18 18 19 18 10 18 11 18 12 18 18 13 14 15 18 16 17 18 18 19 19 10 11 11 12 13 14 15 16 17 18	FPUT TAPE 3, 3001,	9	DU, TE		
REWIND 6 10 CALL INPUT NEX = NEX 17 NEX = NEX 18 NEX = 18 NEX 19 NEX = 18 NEX 19 NEX = 18 NEX 10 NEX = 18 NEX	TAPE 72 TAPE 73 TAPE 73 TAPE 74 TAPE 75 TAPE 76 TAPE 77 TAPE 77 TAPE 77 TAPE 77 TAPE 77 TAPE 77 TAPE 78 TAPE 79 TAPE 81 TAPE 81 TAPE 81 TAPE 81 TAPE 81 TAPE 81 TAPE 82 TAPE 84 TAPE 85 TAPE 86 TAPE 86 TAPE 86 TAPE 86 TAPE 87 TAPE 87 TAPE 87 TAPE 87 TAPE 87 TAPE 88 TAPE 89 TAPE 89 TAPE 89 TAPE 89 TAPE 89 TAPE 90 TAPE		WRITE OUTPUT TAPE 3, 3001,		
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C F CARD ASSIGNMENTS C II NRUNT = JII	ASSIGNMENTS TAPE 76 ASSIGNMENTS TAPE 77 TAPE 80 INT(1) TAPE 80 INT(2) TAPE 81 INT(3) TAPE 82 INT(4) TAPE 82 INT(4) TAPE 83 INT(5) TAPE 84 INT(5) TAPE 85 HER COMSISIENCY CHECK TAPE 86 - NRUNTI 29,21,29 TAPE 87 CONTROL INTEGER CHECK TAPE 89 CONTROL INTEGER CHECK TAPE 89 APE 89 CONTROL INTEGER CHECK TAPE 90 APE 90 APE 91 APE 92 APE 93 APE 94 - IGANTI 29,22,29 TAPE 93 APE 95 - 1,25,28,25 TAPE 95 - 7,25,28,25 TAPE 95 - 7,25,28,25 TAPE 95 - 7,25,28,25 TAPE 95 - 7,25,78,26,32 TAPE 95 - 7,27,40 TAPE 101 - 7,27,740		NEX = NEX	TAPE 7	14
C F CARD ASSIGNMENTS 11 NRUNT = JII 12	ASSIGNMENTS TAPE 77 JII 1 14PE 78 JII 1 14PE 79 JII 1 14PE 79 JII 1 14PE 79 JII 1 14PE 79 JINT(1) 14PE 80 INT(2) 14PE 81 INT(3) 14PE 81 INT(4) 14PE 82 INT(4) 14PE 83 INT(4) 14PE 84 INT(5) 14PE 83 INT(5) 14PE 84 INT(5) 14PE 84 INT(5) 14PE 85 INT(5) 14PE 85 INT(5) 14PE 86 INT(5) 14PE 86 INT(5) 14PE 87 INT(5) 14PE 88 INT(5) 14PE 88 INT(5) 14PE 88 INT(5) 14PE 89 CONTROL INTEGER CHECK 1APE 89 CONTROL INTEGER CHECK 1APE 90 INT(5) 1APE 90 INT(6) 1APE 100 IN			TAPE 7	16
11 NRUNT = JIT	JII	C	F CARD ASSIGNMENTS	TAPE 7	17
IPFH = INT(2)	INT (2)			TAPE 7	19
TP	INT(4)		IPFM = INT(2)	TAPE	11
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1F (NRUN - NRUNT) 29,21,29	- NRUNTI 29,21,29 TAPE 89 CONTROL INTEGER CHECK 1APE 90 - ICANTI 29,22,29 DR EXECUTABLE CONDITIONS 1APE 93 OR EXECUTABLE CONDITIONS 1APE 93 20,25,25 1APE 93 20,26,32 1APE 94 R GROUPS READY TO BE ADDED 1APE 101 27,27,40 TAPE 101			TAPE	36
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21 IF (ICTL - ICANT) 29:22:29 C	- ICANT) 29:22:29 TAPE 92 DR EXECUTABLE CONDITIONS TAPE 93 + 7) 25, 28,25 TAPE 94 + 7) 25, 28,25 TAPE 94 20:26:32 TAPE 94 R GROUPS READY TO BE ADDED TAPE 101 27:27:40 TAPE 101	C		TAPE 6	
C TESTS FOR EXECUTABLE CONDITIONS TA C 22 IF (1TP + 7) 25, 28,25 TA 25 IF (1PFM) 20,26,32 TA	TAPE 93 TAPE 94 TAPE 94 TAPE 95 TAPE 95 TAPE 95 TAPE 95 TAPE 95 TAPE 96 TAPE 97 TAPE 97 TAPE 97 TAPE 97 TAPE 97 TAPE 97 TAPE 99 TAPE 99 TAPE 99 TAPE 101 TAPE	C		IAPE Y	11
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26 IF (IPCN) 27,27,40 TA		26 27	IF (IPCN) 27,27,40	TAPE LO	2.
	TAPE 103	C		TAPE 10	,,
C TA				********* ***	
C 26 IF (IPCN) 27,27,40 TA 7A 74 TA 75 TA		C 22 25 C 26 27	TESTS FOR EXECUTABLE CONDITIONS IF (ITP + 7) 25, 28,25 IF (IPPH) 26,26,32 IEST FOR GROUPS READY TO BE ADDED IF (IPCN) 27,27,40	TAPE S	999999999
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_	GD TÜ 10	TAPE_	-121
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	331 LFMN(L) = INT(1) IPACC = INT(2)	TAPE	128
	GO TO LO 332 IF(NRUNT - JLL) 600, 333, 600	TAPE	130
	333 LIMIT = 10+NUMCON	TAPE	132
_	1GD = LIMIT - 9 IF(LIMIT - IPACC) 335, 335, 334	TAPE	134
	334_LIMIT = IPACC	TAPE _	- 135 136
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	35 LIPACC(L) = IPACC 1F(L - IPFM) 321, 40, 40	TAPE	_ 143
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Ğ.	READY SCRATCH TAPE 8	TAPE	150 151
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ç	ABOUTION OF NEW VALUES AS THE HUMBS OF STREET THAT POUTSTAIN TIME	TAPE	206
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	00 93 K=1,1PACC J = LACH(L,K)	TAPE	211 212

CIIR	BUIL	TINE	TAPE

(CONTINUED)

MASTER LIBRARY TAPE HODIFICATION 53 FGCJL(J) = ACCL(L,K) K = 0 LIST CONTRIBUTOR CODE NUMBERS AND NUMBER OF CONTRIBUTORS PER MOLECULE TO BE MRITTED ON TAPE 3 UO 55 J=1,200 IF (FGCJL(J)) 54,55,54 K = K + L LFGCCN(K) = J FGCL(K) = FGCJL(3) TEST TO LIMIT THE NUMBER OF LINES PRINTED PER PAGE OF OUTPUT IF(M + 1PFGC/6 - 52) 56,57,57 57 WRITE OUTPUT TAPE 3, 3020 H=0 56 M = M + 1PFGC/6 +6 PRINTOUT OF ALTERED LISTS WRITE OUTPUT TAPE 3, 3006 WRITE OUTPUT TAPE 3, 3007, 15FN, (LFGCCN(K),FGCL(K),K=1,IPFGC) INTERIM STORAGE ON TAPE 8 80 WRITE OUTPUT TAPE 8, 2002, 9 ISFN;FN];FN2;IFNC;IFNG;IFNM;INDS;IMEC;[D(K);K=2;6); 1 IPFGC;(LFGCCN(K);FGCL(K);K=1;IPFGC) END OF ALTERATIONS AND ADDITIONS TO DATA GROUPS ON TAPE ALTERATIONS OR ADDITIONS TO CONTRIBUTOR NAME LIST READ CONTRIBUTOR NAMES AND DEPENDENT VARIABLE NAME LIST FROM TAPE READ INPUT TAPE 6, 2003, (GNL(J), J=1,200) READ INPUT TAPE 6, 2003, (DNN(K), K=1,6) TEST FOR ALTERATION OR ADDITION IF (IPCN) 100,100,95 H CARD READING TAPE TAPE TAPE 95 READ INPUT TAPE 2, 1001, 9 (JGNL(K),AGNL(K),K=1,IPCN) 266 267 TEST TO LIMIT THE NUMBER OF LINES PRINTED PER PAGE OF OUTPUT IF(M + 1PCN/7 - 52) 97,98,98 98 WRITE OUTPUT TAPE 3, 3020 M=0 97 M=M + 1PCN/7 +6 PRINTOUT OF ALTERATIONS OR ADDITIONS TO CONTRIBUTOR NAME LIST (JGNL(K).AGNL(K).K+1.IPCN) DO 96 K=1, IPCN J = JGNL(K)_ ADD ALTERED OR NEW NAMES TO LIST 96 GNL(J) = AGNL(K) REVISE GROUP COUNT 100 1PIN = 1PI + 1ADD WRITE OUTPUL TAPE 6, 2000 WRITE OUTPUT TAPE 6, 2001, IPIN CORRECTED GROUPS PREVIOUSLY ON TAPE TAPE TEST TO LIMIT THE NUMBER OF LINES PRINTED PER PAGE OF OUTPUT 115 JF(M - 56) 113-116-116 114 WRITE OUTPUT TAPE 3, 3020 M=0 113 M=M+2 - NO NEW DATA GROUPS ADDED TO TAPE DIAGNOSTIC WRITE OUTPUT TAPE 3, 3011 GO TO 140

HASTER LIBRARY TAPE HODIFICATION		
C (8) - ADDITION OF NEW GROUPS TO TAPE	TAPE TAPE TAPE	31 32 32
C TEST TO LIMIT THE NUMBER OF LINES PRINTED PER PAGE OF OUTPUT	TAPE TAPE	32 32
117 IF(N - 52) 118,116,116	TAPE TAPE	32
116 WRITE DUTPUT TAPE 3. 3020	TAPETAPE	32 -32
118 H=K+5	TAPE TAPE	32 32 33
C PRINTOUT OF NEW GROUPS ADDED TO TAPE	TAPE	. 33 33
WRITE OUTPUT TAPE 3, 3012 120 00 130 [=], [ADD	TAPE_	-33 -33
ISFN = IPI + I KY = I4(1) 120.138-138	TAPE	. 33
IF(M - SW) 129,126,126 128 WRITE OUTPUT TAPE 3, 3020 WRITE OUTPUT TAPE 3, 3012	TAPE	. 33 33
M=0 129 M=M+1	TAPE_TAPE	_33 -34
WRITE OUTPUT TAPE 3, 3013	TAPE	34 34
1 DA(2,1), DA(4,1), DA(3,1), DA(3,1), DA(4,1)	TAPE TAPE	_ 34 34 34
9	TAPE TAPE	_34 34
C TEST TO LIMIT THE NUMBER OF LINES PRINTED PER PAGE OF OUTPUT	TAPE	34 34
C	TAPE	35 35
132 MRIJE OUTPUT TAPE 3. 3020 MBO 131 MBH 66	TAPE TAPE	
WRITE DUTPUT TAPE 3, 3014 DO 135 1=1,1ADQ	TAPE	. 35 35
ISFN = IPI + I KL = (411)	TAPETAPE	35 3535
C TEST TO LIMIT THE NUMBER OF LIMES PRINTED PER PAGE OF OUTPUT	TAPE TAPE	. 35 . 35
C IF(M+I4(1)/6 - 56) 133,134,134 134 MITE OUTPUT YAPE 3, 3020	TAPETAPE	36 36 36
WRITE DUTPUT TAPE 3. 3014	TAPETAPE	36 36
M=6 133 M=M+14(1)/6 +2 135 WRITE OUTPUT TAPE 3, 3007,	TAPE	36
A IZEN* (AT(K*1)*BT(K*1)*K#T*KT)	TAPE	36
C (C) - ADDITION OF CONTRIBUTOR NAME LIST TO TAPE	TAPE TAPE	36 37
[40 WRITE OUTPUT TAPE 6, 2003,	TAPE	31 31
WRITE OUTPUT TAPE 6, 2003, 9 (DNM(K),K=1,6)	TAPETAPE	37 37
END FILE 6	TAPE	31
REWIND 8 GO TO 500	TAPE	31
C END OF OPERATIONS ON ALTERATIONS AND ADDITIONS TO TAPE 2	TAPE TAPE TAPE	37 36 36
C OPERATIONS FOR INITIAL MAKEUP OF TAPE 2	TAPE	- 38 - 38
195 IF (IPCN) 490,490,210	TAPE .	3E
C TITLE CARD READING	TAPE TAPE	38 36
210 READ INPUT TAPE 2, 2000	TAPE TAPE	_ 36 36
C H CARD READING	TAPE TAPE	39
READ INPUT TAPE 2. 1001. 9 (JUNE (K), AGNE (K), K=1, IPCN)	TAPE_ TAPE TAPE	—39 39 39
C DEPENDENT VARIABLE NAME LIST CAND READING	TAPE TAPE	39 39
READ INPUT TAPE 2, 1002, 9 (DNM(K),K=1,6),BLK	TAPE TAPE	39
DO 215 J=1,200	TAPE	34 _ 40
C BLANK DUI ENTIRE CONTRIBUTOR NAME FIELD	TAPE TAPE	40
219 GNL(J) = BLK DD 220 K=1a/PGN	TAPE TAPE TAPE	40 40
J = JGHL(K) C C STORE GROUPS FROM -N- CARD IN CONTRIBUTOR NAME FIELD	TAPE	. 40 40
220 GHL(J) = AGNL(K)	TAPE	. 40
IF (1400) 490,490,230	TAPE TAPE	-::
PRINTOUT OF INITIAL DATA FOR TAPE	TAPE	41
C 230 WRITE OUTPUT TAPE 3, 2000 WRITE OUTPUT TAPE 3, 3010 WRITE OUTPUT TAPE 3, 3009.	TAPE	41
9	TAPE TAPE	- 1
WRITE DUTPUT TAPE 3, 3015, 9 (DNM(K),K=1.6),BLK	TAPE TAPE TAPE	41
C PREPARE TAPE 6	TAPL	42 42
MMITE QUIPUT TAPE 6, 2000 MRITE QUIPUT TAPE 6, 2001,	TAPE	- 12 42

MASTER LIBRARY TAPE MODIFICATION

4 IAOD OO 240 I=1,1ADD Kl = 14(1)	TAPE TAPE TAPE	425 426 427
240 WRITE OUTPUT TAPE 6, 2002.	TAPE	428
9	TAPE	429 430
WRITE OUTPUT TAPE 6, 2003.	TAPE	431
9 (GNL(J), J=1,200) WRITE OUTPUT TAPE 6, 2003,	TAPE	432
9 (DNA(K),K=1,6)	TAPE	~434°
END FILE 6 WRITE OUTPUT TAPE 3, 3016	TAPE .	435
REWIND 6	TAPE	437
C END OF INITIAL PREPARATION OF TAPE 6	TAPE	438 439
c	TAPE	440
GO_TO_500	TAPE.	. 441 442
C ERROR PHINT - NO DATA FOR INITIAL TAPE PREPARATION	TAPE	443
C 490 WRITE OUTPUT TAPE 3, 3017,	TAPE	444
9 IPCN, IADD	TAPE	446
495 REVIND 6.	TAPE "	- 447 448
600 NEX = 2	TAPE	449 450
WRITE OUTPUT TAPE 3, 4000, IC, J11 GO TO 500	TAPE_	451
C	TAPE TAPE	452
C FORMAT STATEMENTS	TAPE	453 454
1Q01 FORMAT	TAPE .	. 455 456
1002 FORMAT (12X, 7A6)	TAPE_	_457
2000 FORMAT(1H1,11X60H	TAPE	458 459
2001 FORMAT	TAPE	460
9 (1H0 616) 2002 FORMAT	TAPE .	- 461 462
9 (1H0 16,246,516,1P5E12.4,16/(1H 16,E12.4,16,E12.4,16,E12.4,16,	TAPE	_463
1E12.4,16.E12.4,16.E12.4)) 2003 FURMAT	TAPE	464
9 (1HO 9(6X, A6)/(1H 6X, A6, 6X,	TAPE	466
146,64,46))	TAPE TAPE	467 468
9 (1H1, 3X, 102HMONSANTO RESEARCH CORPORATION FLAME SPEED CALCULATI	TAPE TAPE	- 469 470
2001 EGRHAT	TAPE	. 47L
9 (1HO,10X, 38HTAPE 2 WRITING INFORMATION - RUN 14) 3002 FORMAT	TAPE	472 473
9 (1HO, 15%, 28H INITIAL TAPE PREPARATION)	TAPE	474
3003 FORMAT 9 1 1HU. 16X,30HDATA OUT OF ORDER - RUN NUMBER 14.	TAPE	475 476
1 14X, 20HMISPLACED RUN NUMBER 14.	TAPE	477
2 /1HO 16X,22HOPTION CONTROL INTEGER 14, 3 22X,21HCONTROL INTEGER CHECK 14)	TAPE	478 479
3004 FORMAT	TAPE_	480
9 (1HO,10X, ZOHNO ACTION CALLED FOR) 3005 FORMAT	TAPE	481 482
9 (1HG.10X, 57HGROUP SERIAL NUMBER INCONSISTENCY - SERIAL NUMB	TAPE	483
1ER = 14 , 5X, 11HLOCATION = 14)	TAPE .	484 485
9 (1HO.10X. 34HALTERATIONS TO DATA GROUPS ON TAPE /	TAPE_TAPE	-486 487
1 1H 14H DATA GROUP ,6X,11HCONTRIBUTOR,6X,11HCONTRIBUTOR,6X,11H 2CONTRIBUTOR,6X,11HCONTRIBUTOR,6X,11HCONTRIBUTOR	TAPE	488
3/ IN . 117H SERIAL CODE COUNT / CODE COUNT / CODE	TAPETAPE	489
5/ 1H . 116H NUMBER NUMBER MOLECULE NUMBER MOLECULE NUMBE	TAPE	491
6R MOLECULE NUMBER MOLECULE NUMBER MOLECULE NUMBER MOLECULE /1	TAPE	_ 49 2
9 (1HG, 110,7X, 6(16,2X,F7,3,2X) /(1H ,17X,16,2X,F7,3,2X,16,2X,F7,3	TAPE	494
1,2X,16,2X,F7.3,2X,16,2X,F7.3,2X,16,2X,F7.3,2X,16,2X,F7.3)) 3008 FORMAT	TAPE	495
9 (1HO, 10X, 32HCHANGES IN CONTRIBUTOR NAME LIST)	TAPE	497
9 (1HO,14H CONTRIBUTOR,6X,11HCONTRIBUTOR,6X,11HCONTRIBUTOR,6X,11H	TAPE	499
ICONTRIBUTOR, 6X, 1 HCONTRIBUTOR, 6X, 1 HCONTRIBUTOR, 6X, 11HCONTRIBUTOR	TAPE_	500 501
3 4HCODE 13X,4HCODE /	TAPE_	502
4 IH , 117HNUMBER NAME NUMBER NAME NUMBER MAME NUMBE 5R NAME NUMBER NAME NUMBER NAME NUMBER MAME	TAPE	503 504
6/11H , 16,2x,46,3x,16,2x,46,3x,16,2x,46,3x,16,2x,46,3x,16,2x,46,3x	TAPE	505
7,16,2X,A6,3X,16,2X,A6_J]	TAPE. Tape	506 507
9 (1HO.10X, 29HINITIAL CONTRIBUTOR NAME LIST)	TAPE	508 509
9 (1HO, 1OX, 32HNO NEW DATA GROUPS ADDED TO TAPE)	TAPE_	10ج
1012 CODMAT	TAPE	511 512
1 IH . 10H FUEL NAME 19X.12HCODE NUMBERS 22X.14HSTOIGHIOMETRIC 11X	TAPE	513
2,13HMAXIMUM SPEED 6X,11HEQUIVALENCE /1H ,13X,103HSERIAL CLASS G BROUP MEMBER DATA EXPERIMENT FLAME FUEL FLAME	TAPE	514 515
4 FUEL RATIO AT /	TAPE_	516
5 1H .39x,77HSOURCE CONDITIONS SPEED CONCENTRATION SPEED 6 CONCENTRATIONMAXIMUM /1H .57x,61H(CM./SEC) _(MOLECULES/CC)_(CM	TAPE	517 518
7/SEC) (MULECULES/CC) FLAME SPEED /)	TAPE	519
3013 FORMAT 9 11H , 246, 17,216, 317, 4x, F9.4, 2x,1PE12.4,2x, OPF9.4,2x,1PE12.	TAPE	520 521
24,3X, QPF8.4)	TAPE_	522 523
3014 FORMAT 9 (1H0,10x, 32HADDITIONS TO DATA GROUPS ON TAPE/ 1 H ,14H DATA GROUP .6x,11HCONTRIBUTOR.6x,11HCONTRIBUTOR.6x,11H	TAPE	. 524
1 IH ,14H. DATA GROUP ,6x,11HCONTRIBUTOR,6x,1HCONTRIBUTOR,6x,1HCONTR	TAPE	525 526
1/ 1M .117M SERIAL CODE COUNT / CODE COUNT / CODE	TAPE	527
4 COUNT / CODE COUNT / CODE COUNT / CODE COUNT / S/ 1M , 11 MM NUMBER NUMBER MOLECULE NUMBER MOLECULE NUMBER	TAPE .	_ 528 _ 529
OR MOLECULE NUMBER MOLECULE NUMBER MOLECULE NUMBER MOLECULE /)	TAPE	530

SUBROUTINE CROUT

MATKIX INVERSION FOR SUBROUTINE MAXM CERT CROUT SUBROUTINE MOD 100 PROBLEM 2018 MARCH 1, 1962 MAC DAYTON FEMILE CROU! NOMENCL ATURE CROUT - NON-ZERO DIAGONAL ELEMENT DIVISON OTVISA ID. M. K. L. J. JT - INDICIES JTCIN - ITERATION COUNTER - NUMBER OF INDEPENDENT VARIABLES IN EQUATIONS - NUMBER OF INDEPENDENT VARIABLES (INPUT) CROUT CROUT CROUT SUBROUTINE CROUT(NVAR, Z, w) DIMENSION X(10,11), Y(10), Z(10,11), W(10) JN-NVAR+1 CROUT CROUT 00 2 1=1.NVAK 00 2 J=1.JN CROUT 2 X(1,J)=2(1,J) 1TC1K=0 CROUT CROUT CROUT CROUT CROUT CROUT CROUT CROUT 3 10= 1 TEST FOR TWO OR HORE VARIABLES IF(NVAR-1)100,100,8 TEST OF ZERO DIAGONAL ELEMENT 8 1F(X(10,(0)) 9,11,9 9 DIVSR= X(10,10) CROUT 00 10 J=10,JN 10 x(10,J)= x(10,J)/DIVSR CROUT CROUT INVERSION OF MATRIX CROUT 00 20 1=11,NVAR 00 20 3=11,JN 20 X(1,J)= X(1,J) -((X(10,J)) (X(1,10))) IF (10-JN+2)121,22,23 CROUT CROUT 38 CROUT SIGNAL FLAG TO INDICATE SOLUTION NOT POSSIBLE 23 SLNSE LIGHT 4 G010 50 CHOUL CROUT CO TO 8 CROUT TEST FOR ZERO DIAGONAL ELEMENT CROUT CROUT CROUT 50 51 52 (F(X) (D, (0)) 24,11,24 SIGNAL FLAG TO INDICATE SOLUTION NOT POSSIBLE CROUT 11 SENSE LIGHT 3 GO TO 50 24 DIVSH = X(ID, [0) CROUT INVERSION OF MATRIX 00 25 J= 10.JN 25 x((0,J) =x((0,J)/01VSR K=NVAK Y(K)= X(NVAR, JN) 126 1F(K-1)150,150,26 26 K=K-1 V(K) = K(K.JN) CROUT 00 30 J=J1,NVAR 30 Y(K) = Y(K)- (X(K,J))*(Y(J)) CO 10 126 50 RETURN CROUT CROUT 100 W(1)* X(1,2)/X(1,1) 1F D(VIDE CHECK 11, 50 CROUT 150 IF (ITCTR) 151,151,200 CROUT COEFFICIENT STORAGE IN OUTPUT VECTOR CROUT 151 DO 352 1 =1.NVAR CROUT 352 W (1) = V(1) GO 10 251 200 DU 201 1 =1,NVAR 201 W(1) = W(1) - V(1) CROUT TEST FOR SATISFACTORY COMPLETION OF SOLUTION CRUUT 1FITCIR-31251,50,50 251 ITCIN = ITCIK +1 DO 152 I = 1,MVAR DO 152 J = 1,NVAR 152 X(1,J) = Z(1,J) DO 153 I =1,NVAR X (1,JM) = -1,0,4 Z CROUT

| DATA CARD IMPUT | SUBROUTINE FOR FLAME SPEED CALCULATIONS | FSCI | 1 | SUBROUTINE IMPUT | FSCI | 2 | COMMON INI, DEC, IC, JII, J2, J3, NIN, NEX | FSCI | 3 | DIMENSION INTI(10), DEC(10), KARRAY(10), PARRAY(10) | FSCI | 4 | NIN - NIN | FSCI | 5 | FSCI | 6 | FSCI | 7 | FSCI | 6 | FSCI | 7 | FSCI |

SUGROUTINE VDECOM

SUGGOUTINE VOECOMIN , KARRAY, P , KPASS)	ABECON
DIMENSION FOLIANT (30), DUMMY(30)	ADECOM
DIMENSION KINPUTITZI, KARRAY(10), PARRAY(10),AIMPUT(72),	- VOECOM
1 KOUTPT(72), AGUTPT(72)	VDEC OM
COMMON TOUMNY, IPLUS, IMINUS, IDECRT, ICOMMA, IE, ISLAMK, 1 KINPUT, NUMDCP, PARRAY, I. L. NEX, NI	YDECOM
EQUIVALENCE (DUNNY 1DUNNY)	
figura, ipus, (Aminus, iminus), (Decpt, idecpt), lcomma, icomma, (8, 18), (alamk, ideam),	ADEC OH
2 (AINPUT, KINPUT), (AQUIPT, KQUIPT)	VDECOM VDECOM
REVINO 5	
NUMBER - N	ADECOM
NEX =1	VOECOH
	VDECON
GO TO! 1.10, 50), KPASS	ADECOM
	VDECOM
PLUS =. 204040404040	VOECOM
AMINUS - 406060606060	ADECOM
B COMMA = 736060606060	ADECOM ADECOM
B E _= 256060606060	
B BLANK = 606060606060	VOECOM
C READ ALPHANUMERIC CHARACTERS 5 READ INPUT TAPE 2,1000, (AIMPUT(J),J=1,72)	VOECOM
I•1	VDECOM
GO TO(10, 10, 50), KPASS	ADECON
C DECOMPOSITION OF INTEGERS	VDECOM
NI = N	VDECOM
C SEARCH FOR START OF NUMBER	VDECOM
101 IF (KINPUT(1) - ISLANK) 102, 11, 102	VDECOM
102 IF (KINPUT(I) - ICOMMA) 12 , 11, 12 11 I= I+1	VDECOM
IF(I -72)101,101, 5	ADECON
SELECT INTEGERS.	VDECOH
12 t1 = t	VDECOM
DO 20 J=1.6	VDECOM
KOUTPT(L) = KINPUT(I)	VDECOM
IF(KINPUT(1) - ININUS) 122, 120, 122 122 1F(KINPUT(1) - IPLUS) 123, 120, 123	VDECOM
120 N = 1	VDECOM
. 123 L = L + L	VDECOM
[= [+]	VDECOM
IF(KINPUT(I) = IBLANK) 121	VDECOM
RIGHT ADJUST IN FIELD	VDECOM
13 IF(J-6) 14,21,14	ADECOM
14_K00* J M 00 .15 K* 1,K00	VDECON
L2 = L1 + 6 - K	ADECOM
	VOECON
15 KOUTPT(L2)= KOUTPT(L3)	ADECON
KDO = 6-J + H	VDECOM
KGO = 1. + M.	VDECOM
00 16 K + KGO, KOO	ADECOM
16 KOUTPT(L4) = 0	VOECOM
60 TO 21	VDECOM
20 CONTINUE	VOECOH
1END = 60 NUMBCP	VDECOM VDECOM
HRITE ALPHANUMERIC CHARACTERS	YDECON
WRITE OUTPUT TAPE 5,1000, (AQUIPT(J), J=1, [END]	VDECOM
REVIND 5.	
C READ INTEGER LIST	VDECOM
REWIND 5	VDECOM
40 RETURN	YDECON
50 CALL DECOCP	VDECOM
MEX = NEX	ADECON
	VDECOM
31 P(J) = PARRAY(J)	VOECOM
50 TO AO.	VDECOM.
1000 FORMAT(1)116)	VDECOM
END	VDECOM

SUBROUTINE DECOCP

SUBROUTINE DECOCP COMMON LOUMNY, IPLUS, IMIMUS, IDECPE, ICOMMA, 18, ISLAMK, 1 KINPUT, NUMDCP, PARRAY, 1, L, NEX, NI EQUIVALENCE (ADUMEY, INLMAY) EQUIVALENCE (ADUMEY, KOUTPT) OIMENSION ADUTPT(72), KOUTPT) DIMENSION ADUTPT(72), KOUTPT(72), PARRAY(101, KIMPUT172) DIMENSION IDUMNY(30), DUMNY(30) DECDCE DECDCP DECOCP DECOCP DECOCP DECOCP NEX = NEX M = L DECDCP DECDCP. DECDCP DECOCP DECOCP. DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECDCP DECDCP DECDCP DECDCP BECDCP DECDCP. DECDCP DECDEP DECDEP 32 DECDCE DECDCP DECDCP DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECOCP DECDCP. DECDCP DECDCP DECDCP DECDCP DECOCP 71 KOUTPT(41) = 0 M = M + 8.8 STORE E IN LOCATION_9. KOUTPT(N! = 12 1FIKINPUT(1) = 12 72 I= 1+1 73 IFIKINPUT(1) = ININUS) 74, 76,74 74. IFIKINPUT(1) = IPLUS) 75, 76...75 75 KOUTPT(M+1) = IPLUS GO. 10 27. STORE SIGN 76 KOUTPT(M+1) = KINPUT(1) 1=1+1 DECDCP DECDCP DECDEP DECOCP C STORE SIGN —76 KOUTPT(H+1) = KINPUT(1) 1=1+1 C. TEST FOR END OF EXPONENT 77 IFIKINPUT(1+1) - IBLANK) 78, 79, 78 78 IFIKINPUT(1+1) - ICJMMA) 78, 79, 78 79 KOUTPT(H+2) = O KOUTPT(H+3) - KINPUT(1) GO TO 792 -791 KOUTPT(H+2) = KINPUT(1) KOUTPT(H+3) - KINPUT(1-1) 792 I=1+2 M = M1 + 12 GO TO 100 C COMPLETE DECIMAL FIELD 80 LOD = M1 + 11 DO 81 J1 = M , LOD 81 KOUTPT(LILL = O M = M1 + 12 100 CONTINUE C MRITE ALPHANUMERIC CHARACTERS MRITE OUTPUT TAPE 5,1000,1ADUITET[J], Jml. 1EMD) IFINUMOEP - 10EC) 201, 201, 200 200 M = 1 N1 = N1 + 1 IEND = 12*(NUMOEP - 6) 10EC = NUMOEP GO TO 504 201 REMIND 5 C READ IMPUT TAPE 5,1010,1PARRAY[J], J=1, NUMOEP) REMIND 5 300 L = M RETURN 1000 GRAAY/*** DECDCP DECDEP DECOCP 300 L + M RETURN 1000 FORMAT(72A1) 1010 FORMATIAFIZ-51

- MOUTINE SOLB MODIFICATION MUM 739 CATE 5/5/61
AND
IN-LETTORS USED
OUP NUMBER Q
ENTAL CONCITIONS NUMBER 1
N RATIO O. CH./SEC
CH./SEC
MS 0. MCLEGULES/GC.
ELOCITY O. MCLEGULES/CC.
NUMBER OF CONTRIBUTORS PER HOLECULE CE PURE
2-0C0 2-000
0200.6
4.000
5,000 6,000 7,000

EXPERIMENTAL CATA

		EXPERIMENTAL D	***		-		
	PIXILRE	EPPERATURE	25.0 DEG. C.	PIXIU	RE PRESSURE	760,0 PM. P	'ERCURY
	ATCKS CF	DANGER TO COMP	PETETA CXIDISE C	NE PCLECULE OF FUE	L 1.00		
			CXICANT 0.21	0			• • • • •
*	VCLUPE PE	A MCLE CF FLEL	2.2414E 04	CC. PER GRAK-HOL	£	· · · · · · · · · · · · · · · · · · ·	
	FLAPE FRONT DIP	ENSIONS				· · · · · · · · · · · · · · · · · · ·	
RUN		***					
735	PEAK HEIGHT (PEASU		.00		_		
	CIAPETER (MEASURED)	41.CCC	30.CCC 21.CC	14-000 6-50	0		
	+EIGHT ICH.)	0	_0.2000_0.4000	C.6000C 0.8C0C	00.94955		
	CIAMETER (CH.) ACTUAL_LENGTH CE.RI	FERENCE4	*000CC CM****	. PEASURED LENGTH	CF REFERENCE.	266.50C00	UNITS
734	PEAK HEIGHT (MEASL)	REC LNITS) _42					
	STATICA (PEASURED CLAPETER (MEASURED)) 1	2		5		
	HEIGHT (CM.)	0.	0.20000 9.4000	13.500 6.50 C.60000 0.800C C.20261 0.0975	0 0.93058		
	CLAPETER (CM.)	0.60788	_C.45C28 0.31520	C.20263_0.0975	6_0	266.50000	UNITS
			.cccc cm.	PLASCRED CENGIN	UP REPERENCE	288.50000	CMIII
	PEAK HEIGHT (MEASURED	RED (N175) 65	.00	4	s		
	STATION (MEASURED DIAMETER (MEASURED DEIGHT (CM.)) 42.0CG	31.COO 22.CC	15.000 8.00	0		
	PERGET (CM.)	0.63516	. C.2CCOC	2. 0.6000C 0.8000	0 <u>0.98299</u>		
	ACTUAL LENGTH OF RE	FERENCE 4	CCOCC CM.	MEASURED LENGTH	CF REFERENCE	264.50000	LINITS
738	PEAK HEIGHT (PEASU		.00				
	STATION (PEASURED)	1 42 000	22 500 24 000	18 000: 11 50	5 6		
•	REIGHT (CH.)	0.	0.20CCC 0.4CCC	C.60000 0.8000	0 1.0000C 1.	.09981	
	ACTUAL LENGTH OF RI	O_63217 EFERENCE 4		18.000 11.50 C.60000 C.8000 C.27119 0.1732 PEASURED LENGTH	<u>6 0.08286 0.</u> Of Reference	265.50000	UNITS
710	PEAK HEIGHT (MEASU						
	STATICH . IMEASURED!	ii_	2	18.50C 11.5C	5.,		
	CIAMETER (MEASURED)	41.5CC	0.20000 0.4000	0 18.500 11.500 0 0.60000 0.8000	0 5.50C 0 1.00000 1.	.09981	
			0.48564 0.3766	0.6000C 0.8000 5 C.27872 0.1732	6 0.08286 0.		
240	ACTUAL LENGTH OF RI	EFERENGE 4 Bec inits) 75	- COCCCCM	PEASURED LENGTH	CF REFERENCE	_ , 265.50000 .	UNITS
770	STATICA (PEASUREC	1	2		5 é		
	PEIGHT (CM.)	42.500	34.000 26.000	19.00C 12.50C	0 7.000 0 1.00000 1.	.11739	
	CIAPETER (CM.)	0.63315	C.5C652 0.38734	C.28305 0.1862	2 0.1 0428 0.	,	
	ACTUAL LENGTH CF RI	EFERENCE 4	CCCCC CP.	PEASURED_LENGTH	OF HEFERENCE	268.50000	UNITS
741	PEAK HEIGHT (PEASUS	ED LN1TS)77	.00				
	STATION (PEASURED)	1 1 43.000	36.000 27.00	21.000 15.00 0 0.60000 0.8000	C 8.50.		
	FEIGHT (CM.)	0.	C.20COC C.4CCC	C.6000C 0.8000	0 1.00CCC 1.	15140	
	ACTUAL LENGTH OF RE	FERENCE 4	.000CC CM.	PEASURED LENGTH	CF REFERENCE	267.50000	ZTINU
742	PEAK HEIGHT (PEASU	REC UNITS) 88	.cc				
	STATIONLMEASURED			24-000 17-50	0 13,000	7.000	
	FEIGHT (CH.)		C.2CCCO 0.4COC	24.000 17.50 1 C.60000 0.8000		20000 1-31099	
	CIAPETER (CM.) ACTUAL LENGTH CE RI	0.65549 EFERENCE4	0.55121 0.45430	0.35754 0.2607 Measured Length	. O. 19367 C. .OF .REFERENCE.	10428 0. 268,50000	UNITS
RUN_			HOLE FRACTION				
	(CC./SEC)	(CC./SEC)	INHIBITOR	(CC./SEC)	(SQ. CM.)	(CM./SEC)	OITAR
735 736	75.2CCC 51.400CC	137.3CCCC	0.	231.95763 249.64099	0.91660	254-73146 277-68917	1.30404
731	107.6000	137.3CCCC	0	267.32434	0.97310	274-71471	1.06592
	124.0000	137.3CC00 126.8CCC0	C.	205.22602 273.76458	1-09941 1_1CBCQ	259.43550 247.07953	2.15031 2.32030
	124.0CCCC						
738 739 740 741	124.00CCC 124.00CCC	116.5CCC0 1C6.2CC00	0.	262.52146 251.27834	1.15208	227.84642 201.55869	2.53423

	CCEFFIC	1EKIS		STANCARD	EGUTVALENCE RAT	IC MAXIMUM
 AL	A2	A3	04	CEVIATION.	AT MAX FLAME SPE	ED FLANE SPEED
 -2.4707E C2	. 1.5045E CS	-3.27186 02	4.1656E 01	1.5729	1.72288	278.0486
 RUN .	EQUIVALENCE	KEASURED	PREDIC		DEVIATION.	PERCENT
 	BATTO	PLAPE SPEEC			· · · · · · · · · · · · · · · · · · ·	REVIATION
735	1.3641	254.7315	255.1	438	-0.4324	-0.2476
 734	1.5450	277.4892	275.1	121	1,4771	0.68Q4
 737	1.8459	274.7147	275.0	816	-1-1669	-0.4230
734	2.1503	255.4355	240.4	419	-1-4244	-0.5448
 739	2.3204	247.0795	244.1	792	0.8003	0.3290
744	2.4141	227-8444	224.4		1.2143	0. 9366
 741	2.7466	201.5587	202.2		-0.4757	-0.3341
742	3.4330	155.2041	199.1		0.0077	Q. QCAB

DATA ACCEPTABLE	IMPIBITORS USES
HYCAGGES	
•	SECUP AURBER O FUEL PEPER MUPARE O
	PENTAL CONCETEINS NUMBER
	273-0486 CP-/SEC
	TENS
FOLLYWALENCE RATIO AT MAXIMUM PLANE SPEED	

APPENDIX B

Fortrar rogram and Sample Printouts for Routine FSR

FLAME SPEED REGRESSION CALCULATIONS

2-21		O.S. MRC7617 RINGROSE	PSA PSA PSA	
'SA	SYMBOL TABLE	RESSION HOUTINE 1922A MRC - DAYTON MARCH 12. 1962	FSR. FSR	
SA			FSR FSR	
	NOMENCLATURE		FSA FSR	
	CGC(K,KUV)	- INPUT LIST OF PRESPECIFIED CONTRIBUTOR	FSR FSR	
	CGCJ(J)	COEFFICIENTS - LIST OF PRESPECIFIED COEFFICIENTS - LLME SPEED DATA	PSH PSH	
	D(K)	- FLAME SPEED DATA - NAME LIST OF DEPENDENT VARIABLE COMPONENTS	FSH FSR	
	FGCJ(J)	- INTERNAL FULL LIST OF CONTRIBUTOR COUNTS	FSR	- 1
	FGCL(K) FNI AND FNZ	- INPUT TAPE LIST OF CONTRIBUTOR COUNTS - FIRST AND SECOND HALVES OF FUEL NAME (ON TAPE)	FSR FSR	-
	FN1L(N) AND		F\$R F\$R	_ i
	FN2L(N)	- FIRST AND SECOND HALVES OF ACCEPTED FUEL NAMES LIST	FSR FSR	-
	GNL (J)	- INPUT TAPE LIST OF CONTRIBUTOR NAMES	FSK	Tì.
	ICFN	- DATA SERIAL NUMBER INDEX - FUEL CLASS NUMBER (ON TAPE)	<u>FSR</u> FSR	-
	IGFN	- FUEL GROUP NUMBER (ON TAPE)	FSK	- 2
	IMFN INDS	- FUEL MEMBER NUMBER (ON TAPE) - DATA SOURCE NUMBER (ON TAPE)	F\$K FSR	
	INEC	- EXPERIMENTAL CONDITIONS NUMBER (ON TAPE)	FSR	- 2
	IPCFN	- NUMBER OF ENTRIES IN INPUT LIST OF ACCEPTABLE FUEL CLASS NUMBERS	F\$R F\$H	_
	IPCTC	- NUMBER OF ENTRIES IN INPUT LIST OF CONDITIONAL TEST CRITERIA	FSH FSH	
	LPCTC3	- NUMBER OF CONDITIONAL TESTS + 3	FSR	
	IPDV IPCGC	- NUMBER OF DEPENDENT VARIABLES TO BE REGRESSED - NUMBER OF ENTRIES IN (KDY)TH LIST OF	FSK FSK	
		PRESPECIFIED COEFFICIENTS	FSK	- 3
	LPGFN	- NUMBER OF ENTRIES IN INPUT LIST OF ACCEPTABLE FUEL CLASS-GROUP NUMBERS	FSR FSR	-
	IPI	NUMBER OF DATA GROUPS ON TAPE 2	FSR	
	IPIGTN	- NUMBER OF DUAL ENTRIES IN INPUT LIST OF CONTRIBUTOR TESTS	FSR FSR	
	IPJ .	- HIGHEST VALUE OF CONTRIBUTOR NUMBER INDEX	FSR	_;
	[PLRC	- NUMBER OF DUAL ENTRIES IN INPUT LIST OF INTEGERS TO OVERRIDE REGRESSION CONTROL	FSR FSR	-
	IPM .	DATA - NUMBER OF INDEPENDENT VARIABLES FOR REGRESSION	FSH FSH	
	IPHG	- NUMBER OF PRESPECIFIED COEFFICIENTS IN	<u>F SR</u>	_
	IPHEN	REGRESSION DATA - NUMBER OF ENTRIES IN INPUT LIST OF	FSK FSR	-
	LPN	- NUMBER OF ENTRIES IN INPUT LIST OF UNACCEPTABLE FUEL MEMBER NUMBERS - NUMBER OF ACCEPTED DATA GROUPS FOR REGRESSION	FSR FSR	
	IPRCL IPRCL	- NUMBER OF ENTRIES IN INPUT LIST OF DECIMAL	FSK	-
	IPSFN	DATA TO OVERRIDE REGRESSION CONTROL DATA - NUMBER OF ENTRIES IN INPUT LIST OF ACCEPTABLE	FSR FSR	-
		DATA SERIAL NUMBERS'	FSR	
	ISFN	- DATA GROUP SERIAL NUMBER (ON TIPE) - CONTRIBUTOR NUMBER INDEX	FSR '	-
	JI. JZ. K. L. MI, AND NZ		FSR FSH	
	ML, AND NZ JGTN	- INDICIES - CONTRIBUTOR COUNT TEST NUMBER	FSR	
	JIN(J)	- CONTRIBUTOR STATUS	FSA	
		2 - INCLUDE (COEFFICIENT PRESPECIFIED)	FSR FSR	
	KDV KDVD	- DEPENDENT VARIABLE INDEX (PROBLEM NUMBER) - DEPENDENT VARIABLE DENOMINATOR IDENTIFICATION	FSR FSK	
		NUMBER	FSR	_ (
	KOVN	- DEPENDENT VARIABLE NUMERATOR IDENTIFICATION NUMBER	FSK	-
	KSFE	- DEPENDENT VARIABLE SCALE FACTOR EXPONENT	FSR FSR	_
	LCCCN(MC)	- LIST OF ACCEPTED CONTRIBUTOR NUMBERS HAVING PRESPECIFIED COEFFICIENTS	FSR FSH	
	LCFN(K)	- INPUT LIST OF ACCEPTABLE FUEL CLASS NUMBERS	FSX	-
	LEGCEN(K,KDV)	- INPUT LIST OF CONTRIBUTOR CODE NUMBERS HAVING PRESPECIFIED COEFFICIENTS	FSR FSR	,
	LCfC(K) LDVD(KDV)	- INPUT LIST OF CONDITIONAL TEST CRITERIA	FSR	
		- IMPUT LIST OF DEPENDENT VARIABLE DENOMINATOR NUMBERS	FSR FSR	
	LDAN(KDA)	- INPUT LIST OF DEPENDENT VARIABLE NUMERATOR NUMBERS	FSR FSA	
	LFGCCN(K)	- INPUT TAPE LIST OF CONTRIBUTOR CODE NUMBERS HAVING POSITIVE COUNTS	FSR FSR	
	LGFN(I,K)	HAVING POSITIVE COUNTS - INPUT LIST OF ACCEPTABLE FUEL CLASS-GROUP	FSR FSR	
		NUMBERS	FSR FSR	
	LGTN(J)	10 - OMIT, 1 - ACCEPT, 2 - REJECT GROUP IF	FSR FSR	-
		TO - ONIT, 1 - ACCEPT, 2 - REJECT GROUP IF COUNT NOT ZERO, 3 - REJECT GROUP IF COUNT ZERO, 4 TO 9 - CONDITIONAL TESTS 1	FSR FSR	-
	LIGTON(K)	- INPUT LIST OF CONTRIBUTOR NUMBERS HAVING COUNT .	FSR	_ (
	LIGTHIKI	TEST ENTRIES - INPUT LIST OF CONTRIBUTOR COUNT TEST NUMBERS	FSR FSR	
	LIPCGC(KDV)	- INPUT LIST OF NUMBER OF ENTRY PAIRS OF	FSR	\neg
	LIVENIM	PRESPECIFIED REGRESSION COEFFICIENTS - LIST OF ACCEPTED INDEPENDENT CONTRIBUTOR	FSR FSR	-{
	•	NUMBERS - INPUT LIST OF UNACCEPTABLE FUEL CLASS-GROUP-	FSR	-:
	LHFN(1,K)	MEMBER NUMBERS	FSR	•
	LOKSFN(N) LRC(K)	- LIST OF ACCEPTED DATA SERIAL NUMBERS - INPUT LIST OF OVERRIDING INTEGER REGRESSION	FSR	
		CONTROL DATA	FSR	_
	LRCC(K)	- LIST OF INTEGER REGRESSION CONTROL DATA - INPUT LIST OF ACCEPTABLE DATA NUMBERS	FSR FSR	
	H .	- INDEX OF ACCEPTED CONTRIBUTORS WITHOUT	FSR	•
	MC SM	PRESPECIFIED COEFFICIENTS - INDEX OF ACCEPTED CONTRIBUTORS WITH	FSR FSR	10
		PRESPECIFIED COEFFICIENTS - INUER OF ACCEPTED DATA GROUPS - ACCEPTABLE DATA SOURCE MURBER	FSR	ũ
	NOS	- INDEX OF ACCEPIED DATA GROUPS	F SIL	+

ROUTINE FSR (CONTINUED)		
FLAME SPEED REGRESSION CALCULATIONS		
WRITE OUTPUT TAPE 3, 1030, 9 (LCRN(K),K=1, IPCFN)	PSR PSR	209 210
C TEST FOR NO ENTRIES IN FUEL CLASS-GROUP NUMBER INPUT LIST	- FER	- <u>211</u>
32 (F (1PGFN) 24,34,33	FSA FSA	-213
C N CARD MEADING	FSR FSR	215
33 READ IMPUT TAPE 2, 1000,	FSH FSH	217
MRITE OUTPUT TAPE 3, 1015	FSR FSR	220 219
9 (LGFN(1,K),LGFN(2,K),K=1,1PGFN)	FSR FSR	222
C TEST FOR NO ENTRIES IN FUEL CLASS-GROUP-MEMBER NUMBER INPUT LIST	F\$R	223
34 IF (1PMFN) 24,40,35	FSR FSR	225 226
C O CARD READING	FSR FSR	227 228
35 READ INPUT TAPE 2, 1000, 9 (IMPM(3-K)-IMPM(2-K)-IMPM(3-K)-K-1-IPMPM)	FSR	239
WRITE OUTPUT TAPE 3, 1016	F\$R	231 232
WRITE OUTPUT TAPE 3, 1039, 9 (LHFN(1,K),LMFN(2,K),LMFN(3,K),K=1,1PMFN)	FSR	234
C TEST FOR NO ENTRIES IN CONTRIBUTOR TEST INPUT LIST	FSH FSH FSR	235 236 237
40 IF (IPIGTN) 24.55.41	FSH FSH	238 239
C P CARD READING	FSR	240
41 READ INPUT TAPE 2, 1000,	FSR FSR FSH	242
WRITE OUTPUT TAPE 3, 1017	FSR	244 244
9 (LIGTCN(K),LIGTN(K),K=i,1PIGTN)	FSR FSR	245
C SET UP COMPLETE LIST DE CONTRIBUTOR COUNT TEST NUMBERS C - 0 - OHIT C - 1 - ACCEPT	FSR FSR	248
C - 2 ~ REJECT GROUP IF COUNT NOT ZERO	FSR FSR	250
C -3 - REJECT GROUP IF COUNT JERO C -4 TO 9 - CONCITIONAL TESTS	FSR FSR	251
00 48 K=1;1P1GTM J1 = LIGTGNIX 1F (K - IP1GTN) 44,43:42	FSR	253 254
C PAUSE REMOVED	FSR FSR	255_ 256_
42 CONTINUE	FSR FSR	257_ 258_ 258_
C SET CONTRIBUTOR CODE NUMBER LIMIT	FSH.	260
43 J2 - IPJ G0 T0 45	FSR	262
C REAJUST UPPER LIMIT TO NOT OVERLAP NEXT FIELD	FSR FSR FSR	263 264 265
44 J2 = LIGTCN(K+1) - 1	FSH	266
C STORE CONTRIBUTOR COUNT TEST NUMBERS IN SEQUENCE	FSR FSR	268
45 00 48 J= J1.J2	FSR FSR	270
LGTN(J) - LIGTN(K) IF ILGTN(J) 1-40,47,48 C PAUSE RENOVED	FSR FSR	271
46 CONTINUE	FSH FSH	273
48 CONTINUE	FSR FSR	275
C TEST FOR NO ENTRIES IN CONDITIONAL TEST CALTERIA LIST	FSR FSR FSR	277 278 279
50 (F (1PCTC) 24,55,5) 51 (PCTC) = (PCTC + 3	FSR	280
C Q CARD READING	FSR FSR FSR	281 282 283
	FSH FSR	284
READ INPUT TAPE 2, 1000, 9 (LCTCIK),K=4,IPCTC3) WHITE QUIPMI TAPE 3, 1018	FSR	286 287
MRITE OUTPUT TAPE 3, 1018 WRITE OUTPUT TAPE 3, 1030, 9 (LCTCKT, K-4, PPCTC3)	FSR FSR FSR	286
	FSR FSA	290 291
C SET UP ESSO REGRESSION CONTROL DATA C INITIALIZE WITH STANDARD VALUES OF DECIMAL QUANTITIES	FSH	292
55 RCCL(1) = 0.001	FSR FSR FSK	293 294 295
RCCL(2) = 0,00002 RCCL(3) = 0.00001	FSH FSH	246
C INITIALIZE WITH STANDARD VALUES OF INTEGER QUANTITIES	FSR	294 294
	FSR FSR FSR	300 301
0U 56 Re4;11 56 LNCC(S) = L LRCC(S) = U	FSR FSA	302
LHCC(10) - 0	FSR	304 305
C YEST FOR NO ENTRIES IN DECIMAL OVERRIDE LIST	FSH FSH FSH	306
IF (IPACL)24,58,57	FSR FSR	308
C R CARD REAUING	FSN	310
C SUBSTITUTE OVERHIDING DECIMAL VALUES	FSH	-311

ROUTINE FSR (CONTINUED)		
FLAME SPEED REGRESSION CALCULATIONS		
\$7 READ INPUT TAPE 2, 2001,	FSR FSR	313
G (RCCL(K),K=1,3)	FSR FSR FSR	316 316 317
C TEST FOR NO ENTRIES IN INTEGER OVERRIDE LIST	FSH FSH	318 319
\$8 IF (IPLRC) 24,61,59 C C S CARD READING	FSH FSR	320
59 READ INPUT TAPE 2, 1000.	FSR FSR	322
9 (NRC1(K),LRC(K),K-1,IPLRC)	FSR FSR	324 325
C SUBSTITUTE OVERTOING INTEGER VALUES	FSA FSA	326 327
00 40 K=1,1PLRC L = NRC1(K)	FSA FSA	328 329
60 LRCC(L) = LRC(K)	F SH F SR	330 331
C	F S R F S R	332 333
61 WRITE OUTPUT TAPE 3, 1019 WRITE OUTPUT TAPE 3, 1032,	FSR FSR	334 335
9 (RCCL(K),K=1,3),(LRCC(K),K=4,11) C	FSR FSR	336 337
C SET UP LIST OF DEPENDENT VARIABLE CODE NUMBERS AND NUMBER OF C CORRESPONDING PRESPECIFIED REGRESSION COEFFICIENTS	FSH FSH FSR	334
65 DO 67 KDV = 1,1PDV	FSR FSR	340 341 342
C T CARD READING	FSR FSR	343
READ INPUT TAPE 2, 1000, 9 LOVN (KDV), LOVD (KDV), LIPCGC (KDV)	FSR FSR	345 346
C TEST FOR NO PRESPECIFIED REGRESSION COEFFICIENTS	FSR FSR	347
C IF (LIPCGC(KUV)) 24,67,66	FSH FSH	344 350
66 IPCGC - LIPCGC(KDV)	FSR FSH	351 352
C U CARD ASSIGNMENTS	FSR FSR	353 354
660 CALL INPUT M = 0	FSH FSH	_35 <u>5</u> 356
LIMII = 10+1C IGO = LIMIT - 9	FSH FSH	358
IF (LIMIT - IPCGC) 662, 662, 661	FSR FSR	359
662 DU 663 K = [GO, LIMIT K = M + 1	FSR FSR	362
LCGCCN(K,KUY) = UEC(H) 663 CGC(K, KUY) = UEC(H) 1F (_LIMIT - IPCGC) 660, 67, 67	FSR FSR FSR	363 364 365
67 CONTINUE	FSR	366 367
C START OF FIRST TAPE 6 PASS C	FSR FSR FSR	368
C HEADING READING	FSR FSR	370 371
100 READ INPUT TAPE 6. 1002	FSR FSR FSK	372 373
C	FSK	374 375
READ INPUT TAPE 6, 1003, IPI 0(1) = 1.0	FSR FSR	376 377
N = 0 00 190 1-1,1P1 READ INPUT TAPE 6, 1004,	FSR FSR	378 379
9 ISFN, FN1, FN2, ICFN, IGFN, IMFN, INDS, INEC, (D(K1,K=2,6)	FSR FSR FSR	380 381
C TEST FOR DATA GROUP SERIAL NUMBER SEQUENCE	FSR FSR	382 383 384
G IF (1 - ISFN) 104,104,104	FSR FSR	385
C PAUSE REMOVED 104 CONTINUE	FSR FSR	387
C TEST FOR LIMIT OF 300 ACCEPTABLE DATA GROUPS	FSA FSA	389 390
106 IF (N-300) 110,107,105	FSR FSR	391
C PAUSE REMOYED	FSR FSR	393 394
107 PFAIL = 3.0 GO TO 190	FSH FSH	396
C START TESTING SEQUENCE FOR ACCEPTABLE REGRESSION DATA	FSR FSR	397
110 1F (1P\$FN) 111,120,112	FSR FSR	400
C PAUSE REMOVED	FSR FSK	402
TEST FOR UNACCEPTABLE DATA GROUP SERTAL NUMBERS	FSR FSR FSR	404 405
112 DO 113 K = 1,1P5FN 15 (1 - 15FN(K)) 113,140,113	FSK FSK	406
IF (1 - LSFN(K)) 113,190,113 113 CONTINUE 120 IF (1PCPN) 111,123,121	FSH	408
C 1EST FOR ACCEPTABLE FUEL CLASS NUMBER	FSR FSR FSR	409 410 411
	FSH FSR	412
121 00 122 K=1,1PCFN IF (1CFN - LCFN(K)) 122,123,122 122 CONTINUE	FSR FSR	414
GO TO LYO	FSR	115

CONTINUED
123 IF (IPGFN) 111,126,124 FSR 4
TEST FOR ACCEPTABLE FUEL CLASS-GROUP NUMBERS FSR 4 FSR 4
TEST FOR ACCEPTABLE FUEL CLASS-GROUP NUMBERS FSR 4 FSR 4
124 DO 125 K= 1PGFN F5R 4
1241 F 116FM-LGFN12,K) 125,126,125 FSK 5 125 CONTINUE FSK 6 126 F (1PMFN) 111,130,127 FSK 6 127 128 FOR ACCEPTABLE FUEL CLASS-GROUP-MEMBER HUMBERS FSK 6 127 100 128 K=1,1PMFN FSK 6 127 101 128 K=1,1PMFN FSK 6 127 127 128 FSK 6 127 128 128,127 128,1272,128 FSK 6 127 128 (1PMFN-LMFN(2,K)) 128,1272,128 FSK 6 128 CONTINUE FSK 6 130 15 (MUS) 111,135,131 FSK 6 C TEST FOR ACCEPTABLE DATA SOURCE NUMBER FSK 6 131 15 (INUS - NUS) 190,135,190 FSK 6 135 15 (MEC) 111,140,135 FSK 6 C TEST FOR ACCEPTABLE EXPERIMENTAL CONDITIONS NUMBER FSK 6 136 15 (INUS - NFC) 190,140,190 FSK 6 C TEST FOR ACCEPTABLE EXPERIMENTAL CONDITIONS NUMBER FSK 6 136 15 (INUS - NFC) 190,140,190 FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 6 C TEST FOR AN UNDEFINED D
GO O O O F58 S
FSR SECTION ACCEPTABLE FUEL CLASS-GROUP-MEMBER NUMBERS FSR SECTION SECTION FSR SECTION SECTION
127 OU 126 K=1,1PMPN
F
1272 F (FR- FN(3,K)) 128,190,128
130 F (NUS) 11, 135, 131 F.SR. 4
C TEST FOR ACCEPTABLE DATA SOURCE NUMBER FSK 4 C 131 IF (INUS - NOS1 140,135,190 FSK 4 135 IF (INEC) 111,140,136 FSK 4 C TEST FOR ACCEPTABLE EXPERIMENTAL CONDITIONS NUMBER FSK 4 C 136 IF (INEC - NFC) 190,140,190 FSK 4 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 4 C FSK 5K 4 C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSK 4 C FSK 5K 4
131 IF (1NUS - NOS1 190,135,190 F5R 4 135 IF (NEC) 111,140,136 F5R 4 C
135 1F (NEC) 111,140,136 FSR 44
136 IF (INEC - NFC) 190,140,190 FSR 4-
136 IF (INEC - NEC) 190,140,190 F3K 4: C TEST FOR AN UNDEFINED DEPENDENT VARIABLE F5K 4:
C TEST FOR AN UNDEFINED DEPENDENT VARIABLE FSM 4
C (UNACCEPTABLE IF EITHER NUMERATOR OR DENOMINATOR ZERO) FSR 44
C FSR 44
K = LÖVNIKÖV) FSR 4 1F (D(K)) 141:190:14) FSR 4
141 K = LOVD(KOV) FSR 4: IF (D(K)) 142,190,142 FSR 4:
142 CUNTINUE FSN 4 150 IF (IPIGIN) 111-180-151 FSN 4
C FSR 4.
C FSR 4
152 FGCJ(1) = 0.0 FSR 40 00 153 K=1,1PFGC FSR 40
J = LIGCCN(K) FSK 4
C STOKE CONTRIBUTOR NUMBERS FROM GROUP BEING TESTED FSN 40
193 FGCJ(J) = FGCL(K) FSR 4 UU 194 K=4,9 FSR 4
N4(K) = U FSR 44
154 NMZ(K) = 0
C - FSR 4 DO 165 J = L, IPJ FSR 4
JGTN = LUTNEJ) FSR 4 C FSR 4
C CONTRIBUTOR COUNT TEST 2 - ONLY ZERG COUNTS ACCEPTED FSR 4
C FSR 4 1F (JGTN - 2) 165,156,157 FSR 4 156 1F (FGCJ(J)) 190,165,190 FSR 6
C FSR 4
C CONTRIBUTOR COUNT TESTS 4 TO 9 FSR 4
C F\$R 4 157 1F (JGTN - 3) 158,159,160 F\$R 4 C PAUSE REMOVED , F\$R 6
158 CONTINUE FSR 4 159 IF (FCCJ(J)) 165,190,165 FSR 4
160 F (FGCJ(J)) 161,162,161 FSR 4
C SUM OF NON-ZERO VALUES OF INDEX (JGTN) FSR 4 C SUM OF NON-ZERO VALUES OF INDEX (JGTN) FSR 6
161 NNZ(JGTN) = NNZ(JGTN) + 1
FSR 4
FSR 4
162 NZ(JGTN) = NZ(JGTN) + 1 FSR 4 165 CONTINUE FSR 4 1F (1PCTC) 111,180,171 FSR 4
C FSA S
C FSR 5
IF (LCIC(K)) 172.175,173 FSA 5
173 IF (NN2(K) - LCTC(K)) 190,175,175 FSR 5
175 CONTINUE
FSN 9
J = LFisCCN(K)
C
IF (JIN(J) + 1) 182,181,182
LOZ CONTINUE FSR >
N = N + 1 FSR 5 LUKSFR(N) = 1 FSR 5

	ROUTINE FSN (CONTINUED)		
:	FLAME SPEED REGRESSION CALCULATIONS		
Ę	SETUP OF DESIRED DEPENDENT VARIABLE	FSR FSH	521 522
C	DO 189 KOV - 1,1POV	FSH FSH	- 523 524
	KOAD = FOAD(KDA) KOAN = FOAN(KDA)	F S R F S R	525 526
_	Y = O(KDYM)/D(KDYD) IPCGC = LIPCGC(KDY)	FSR FSR	<u>527</u> 526
£	TEST FOR NU PRESPECIFIED COEPFICIENTS	FSH FSH	529 530
<u>c</u>	IF (1PCGC) 111,189,184	FSK FSR	_532 _532
-	184 DO 188 K=1,1PFGC J = LFGCCN(R)	FSR FSR	_534
ç	TEST ONLY THUSE CONTRIBUTORS WHICH ARE NOT TO BE CHITTED	FSK FSK	535
٤.	1F (JIN(J) ~ 1) 188,185,188	FSR FSR	537 538
Ç	185 DO 186 L- 1,1PCGC	FSR FSR	_534 540
Č	TEST EACH CONTRIBUTOR IN GROUP	FSR FSK FSK	541 542 543
	186 CUNTINUE GO TO 188	FSR FSR	544 545
ç		FSR FSR	546 547
č	ADJUST VALUE OF DEPENDENT VARIABLE 187 Y = Y - CGC(L,KDY) • FCCL(K)	FSK FSR	548 549
_	188 CONTINUE	FSR FSR	550 551
- <u>c</u>	DETERMINE MAXIMUM VALUE OF Y FOR SCALING TO FIT ESSO OUTPUT	FSK FSK	552
Ť	[B9 YMX(KDV) = MAXIF(YMX(KDV),ABSF(Y)) FNIL(N) = FNI	FSR FSR	554 555
_	FN2(N) = FN2 190 CONTINUE	FSR FSR	256 251
_	IPN = N	FSK FSK	558 559
	READ IMPUT TAPE 6, 1005, (GML(J). J=1,200) READ IMPUT TAPE 6, 1005, (DMMIK), K=1,6) REMIND 6	FSR FSK	560 561
Č	END OF FIRST TAPE 6 PASS	FSR FSR	563 563
2	TEST FOR NO ACCEPTABLE DATA	FSR	564
운	1F (1PN) 191,191,192	FSR FSR	566 567
Č	DIAGROSTIC - NO DATA ACCEPTABLE - PROCESS NEXT RUN	FSH FSH	568 569
ç	LV1 WRITE OUTPUT TAPL 3, 1025	FSA FSR	570 571
<u> </u>	GO YO 302	FSK FSR	572 573
듣	PRINT LIST OF ACCEPTABLE DATA SERIAL NUMBER AND FUEL NAMES	FSR FSR	574 575
_	192 LRCC(3) - IPN WRITE OUTPUT TAPE 3, 1022	FSK FSR	576 577
_	193 WRITE DUIPUT TAPE 3, 1034, 9 (LOKSFM(M), FN]L(M), FNZL(M), N=1, IPM)	FSR FSR	578 579
Ç	TEST FOR DIAGNOSTIC PRINTOUT - FIRST 300 DATA GROUPS USED	FSR FSR	581 581
7	IF (PFAIL - 3.0) 200.194.200	FSR FSR	582 583
_	194 WRITE OUTPUT TAPE 3, 1027 PFAIL = 0.0	FSR FSR	584 585
C	GENERATION OF ESSO REGRESSION INPUT DATA	FSH FSH	586 587
ç	SET UP DEPENDENT VARIABLE	FSK FSR	588 589
τ.	200 DU 300 KDV=1, IPDV	FSR FSR	540 541
	KOVN = LOVN(KOV)	FSR	592 593
	1PCGC = L1PCGC(KDV) 1F (1PCGC) 24,210,206	FSH FSR	594 595
_	206 DO 207 J=1, IPJ 207 CGCJ(J) = 0.0	FSA FSR	596 597
Ç	SET UP LIST OF PRESPECIFIED COEFFICIENTS	F SR	548 544
<u>۔</u>	00 204 K = 1,1PCGC	FSH FSR	601
	J = LCGCCN(K,KDV) CGCJ(J) = CGC(K,KDV)	FSH FSH	603 603
ç	1F (JiN(J) - 1) 209,208,209	FSH FSH	604 605
Ç	SET JIN(J) = 2 FOR CONTRIBUTORS WITH SPECIFIED COEFFICIENTS ONLY	FSH FSH	606
۲	208 JIN(J) = 2	FSR FSR	604
÷	DETERMINE NUMBER OF INDEPENDENT VARIABLES FOR REGRESSION	FSR FSR FSR	611
	210 M = 0	FSH	612
2	MC = 6 00 213 J=1,1PJ	FSR FSN	614
<u>د</u>	TEST FOR STATUS OF CONTRIBUTOR	FSA FSA FSA	616
-c-	IF (JIN(J) - 1) 213,211,212	FSR	618
<u>.</u> خ.	INCHEMENT NUMBER OF DEPENDENT VARIABLES INDEX	FSH FSH FSH	-620 -621 -622
_	211 6 4 6 4 1	FSK FSK	627

ROUTINE FSR (COMTINUED)		
FLAME SPEED REGRESSION CALCULATIONS		
		4.55
OGNL(N) = GNL(J) GO TO 213	FSR FSR	626
INCHEMENT NUMBER OF PRESPECIFIED COEFFICIENTS INDEX	FSR	628
C 212 MC = MC + 1	FSH.	630
OCGNL(MC) = GNL(J) LCCCN(MC) = J	FSR FSR	632
213 CONTINUE IPM = M	FSK FSK	633
IPMC - MC	FSR FSK	635 636
C TEST FOR EXCEEDING LINIT OF DEPENDENT VARIABLES COUNT OF ESSO C REGRESSION PROGRAM	F SH F SH	<u>637</u> 638
[F (1PH-57) 220,220,216	FSR FSR	639
216 PFAIL = 1.0 Gi TO 260	FSH_ FSH	_641 642
C FINAL MAKEUP OF ESSO REGRESSION CONTROL DATA	FSR FSR	_644
6	FSR	645
220 LRCC(1) = KDV LRCC(2) = 1PM + 1 LRCC(3) = 1PM	FSR FSR	641
	FSK FSR	_648 649
C WRITE TITLE AND CONTROL DATA FOR REGRESSION ANALYSIS C	FSH FSH	650 651
WRITE OUTPUT TAPE 7, 1006 WRITE OUTPUT TAPE 7, 1007, (RCCL(K),K=1,3), (LRCC(K),K=1,11)	FSH FSK	653
C	FSH FSR	455
C	FSH FSR	656
READ INPUT TAPE G. 1003, EPI	FSR	454
C CALCULATION OF DEPENDENT VARIABLE SCALE FACTOR	FSH FSH	_659 660
KSFE = 0	<u>FSR</u> FSK	661 662
C REDUCE POWER OF 10 UNTIL YMX LESS THAN 1000.	FSH FSH	663
221 [F (YMX(KDV) - 1000.) 223,222,222	FSR FSR	_665 666
222 YMX(KDV) = YMX(KDV)/10.0 KSFE = KSFE + 1	FSH FSK	_668
GO TO 221	FSR FSR	669
C INCREASE PUNER OF 10 UNTIL YMX GREATER THAN 100.	FSH	670 671
223 IF (YMX(KDV) - 100.0) 224,230,230	FSR FSR	672 673
224 KSFE = KSFE - L YMX(KUV) = 10.00YMX(KUV)	FSK FSK	674 675
GO TU 223	FSN FSR FSR	676 677
C CHOOSE ACCEPTABLE DATA GROUPS FAON TAPE	FSH	678
230 UO 255 N. = 1,1PN	FSR FSR	680
231 READ INPUT TAPE 6, 1004, 9 ISFN, FN1, FN2, ICFN, IGFN, IMFN, IMDS, INEC, (Q(R), R=2,6)	FSR FSR	681
1 ,1PFGC,(LFGCCN(K),FGCL(K),K=1,1PFGC)	FSR FSR	683
C TEST FOR ACCEPTABLE SERIAL NUMBERS	FSA FSA	685
IF (ISFN - LUKSFN(N)) 231,235,232 C PAUSE REMOVED	FSR FSR	688
232 CONTINUE 235 OU 236 J = 1,1PJ	FSR	689
236 FGCJ(J) = 0,0 DU 237 K = 1,1PFGC	FSR FSR	691
J = LFGCCN(K)	FSK	643
237 FGCJ(J) = FGCL(K)	FSR FSR	694 695
C PREPARE LIST OF INDEPENDENT CONTRIBUTOR COUNTS	FSR FSR FSR	696 647
DO 238 M = 1,1PM J = L[VCN(M)	FSK FSK	644
238 OPL(M) = FGCJ(J)	FSR FSN	700 701
C CALCULATION OF DEPENDENT VARIABLE	FSR FSR	702
240 Y = 0(KDVN)/D(KDVD)	FSR	704
C TEST FOR NO PRESPECIFIED COEFFICIENTS	FSH	705
C [F [[PMC] 241,250,242	F SR F SR	707 708
C PAUSE REMOVED .241 CONTINUE	FSR FSR	709
242 DO 243 MC = 1,1PMC J = LCCCN(MC)	FSR FSR	711
C DEPENDENT VARIABLE ADJUSTMENT FROM PRESPECIFIED COEFFICIENTS	FSR FSR	713 714
C 243 Y = Y - CGCJ(J) • FGCJ(J)	F S R	715
C DEPENDENT VARIABLE SCALING	FSR FSR	_/;;
C	FSH	719
250 Y = Y-10.0-0-(-KSFE) C HRITE DATA FUN KEGRESSION ANALYSIS	FSR FSK FSK	720 721 722
	FSK	723
SEE CHILINGE 19 TOOR TEND (OPECHIONET 1 TEND)	FSH FSH	725
KEWINO 6	FSH FSR	726
C CND OF SECOND TAPE & PASS	F\$R F\$H	-131

ROUTINE FSH (CONTINUED		
(44111716)	J	
FLAME SPEED REGRESSION CALCULATIONS		
C		729
C PRINTOUT OF SUCCESSFUL DATA PREPARATION INFORMATION	FSR FSR	730
260 WRITE OUTPUT TAPE 3, 1010,	FSR FSR	731 732
WRITE OUTPUT TAPE 3, 10101,	FSH FSH	733 734
WRITE OUTPUT TAPE 3, 1020 ,	FSR FSR	/35 /36
9 KSFE,DNM(KDVN),DNM(KDVD) 1F (1PCGC) 24,262,261	FSH FSH	/37 /36
261 WRITE OUTPUT TAPE 3, 1021 ,	FSA FSA	73 <u>9</u> 740
WRITE OUIPUT TAPE 3, 1033. 9 (LCGCCN(K,KDV),CGC(K,KDV),K=1,1PCGC)	FSH FSH	741 742
C TEST FOR NO INDEPENDENT VARIABLES	FSR FSR	743 744
C 262 1F (1PM) 270,270,263	FSH FSH	745 746
C PRINTOUT OF INDEPENDENT CONTRIBUTORS WITH THEIR REGRESSION		747 748
C INDICIES	FSR FSR	750
263 WRITE OUTPUT TAPE 3, 1023 WRITE OUTPUT TAPE 3, 1035,	FSA	751 752
(NOL(K), K=1,10) /		753
C PRINT DUT FIRST 9	FSH	754 755
M2 = XMINOF(Y.1PM)	FSH FSH	156 157
WRITE OUIPUT TAPE 3, 1036, 9 (LIVCN(M), DGNL(M), M=1,M2)	FSR	758 759
IF (IPM - 9) 270,270,265 265 LNX = IPM/IQ	F SR	760 761
	FSH FSK	762 763
C PRINT OUT IN SEQUENCES OF 10 C DO 266 LN = 1,LNX	FSR	764 765
H1 = 10+LN H2 = XMINOF (M1+9,1PM)	FSR	166 761
266 WRITE OUTPUT TAPE 3, 1037, 9 H1,(LIVCN(M),OGNL(M), M=M1,M2)	FSR	168
270 1F (IPMC) 280,280,271	FSR	769 770
C PRINTOUL OF NAMES OF CONTRIBUTORS WHICH HAVE PRESPECIFIED	FSR	771 772
C COEFFICIENTS	FSK	774
271 WRITE OUTPUT TAPE 3, 1024 LNX = 1 + (IPMC - 1)/10		775 776
DO 272 LN=1,LNX MC1 = 10=LN - 9		777 778
MC2 = XMINOF(MCL+9, LPMC) 272 WRITE OUTPUT TAPE 3, 1038,	FSR	779
9 (!CCCM(MC), OCGM!(MC), MC=MC1,MC2) 280 IF (PFALL - 1.0) 290,281,290	FSR	781 762
<u>C</u>	FSR FSR	783
	FSR	784 785
281 WRITE OUTPUT TAPE 3, 1026 PFAIL = 0.0	` FSR	786 787
GO TO 2901 290 PFAIL = 0.0	F\$R	788 789
REVIND 7	FSK FSK	790 791
INTAPE = 7 C CALL ESSO REGRESSION PROGRAM	FSR	742 793
	FSR	794 745
CALL \$504 (INTAPE) 2901 00 300 J- 1, [PJ 1F (JIN(J) - 2) 300,292,291	FSR FSR FSR	796 797
C PAUSE REMOVED	FSH	198
291 CONTINUE 292 JIN(J) = 1	FSH	799 800
300 CONTINUE	FSK	802 802
C TEST FOR END OF CALCULATIONS	FSR	803 804
302 IF(LAST)301,20,301 301 NEWIND 7	FSR	805 806
MEMIND 6 WHITE OUTPUT TAPE 3, 2000	FSA FSK	807 808
60 TO 20	FSR	804 610
C FORMAL STATEMENTS	FSN	811 812
1000 FURMAT (1814) 1001 FURMAT (72H	FSK	813 814
1001 FORMAT 172H	FSR	815 816
1	FSR	817
1003 FORMAT (1H0 616) 1004 FORMAT	FSR	814
9 (1HU 16,2X6,516,1P3E12.4,16/(1H 16,E12.4,16,E12.4,16,E12.4,16, 1E12.4,16,E12.4,16,E12.4))	FSK	P51
1005 FORMAT 4 (1H0 4(6x,A6)/(1H 6x,A6,A6,A6,A6,A6,A6,A6,A6,A6,A6,A6,A6,A6,	FSA	822 823
14G,6X,4611 1906 FORMAT (72H	FSH ————————————————————————————————————	824 825
1007 FORMAL (3F10.5,315,13,712)	FSR FSR	826 827
1008 FORMAT (17,5%,195E12.4 / (6E12.4))	F SK F SK	628 629
9 (1H1, 3X, YEHMONSANTO RESEARCH CORPORATION FLAME SPEED REGRESS	TO FSM	¥30 °
IN - ROUTINE 1922 - MODIFICATION L - RUN 14)	FSH.	#31 #32

ROUTINE FSA

SURBOUTTHE FESOA MULTIPLE LINEAR REGRESSION CALCULATIONS ES 504 SYMBOL TABLE CESSO2 ESSO REGRESSION SUBROUTINE MOD 4 ESSO4 PRESPECIFIED INPUT FORMA! 6F12.5 VARIABLE INPUT TAPE SPECIFICATIONS ESS04 DIMENSION DATATAS DI PRESTONICA DE LA CONTRE L SUBROUTINE ESSO4 (INTAPE) DIMENSION DATA(60), VECTOR (60,60), AVE (60), SIGMA(60), COEN (60), SIGMCO E \$ \$ 04 E \$ \$ 04 ESS04 ESS04 ESS04 ESS04 INDATA = 1 NRUNSE = 1 IDEPSE = INVAN + 1 IMEIGT = INVAN + 2 GO TO (101, 102), INDATA 101 WRITE OUTPUT TAPE 3, 5003, (MEAD(I), 1 = 1, 12) WRITE OUTPUT TAPE 3, ESSO4 ESSO4 ESS04 9 G, TOL, EFIN, EFOUT, MOPROB, INVAR, NODATA, IFWT, IFSTEP I, IFRAW, IFAVE, IFRESD, IFCOEN, IFPRED, IFCNST ESSO4 102 DU 4020 1=1,1NVAR 4020 COEN(1)=0.0 ESSO4 COENTI 190-0 IFFYT = 1.THEN ALL WHTS = 1.0 IFFYTEP = 1, DO NUT PRINT EACH STEP IFRAM = 1 DO NOT PRINT RAW SUMS AND SQUARES IFAVE = 1 DO NOT PRINT AVERAGES IFAVE = 1 DO NOT PRINT RESIDUAL SUMS SQUARES IFFES = 1 DO NOT PRINT PRITAL COEFFFICIENTS IFFES = 1 DO NOT CALC PREDICTED VALUES IFFNS = 1 DO NOT CALC PREDICTED VALUES INDAIA = 1, LIST IMPUT DATA ON TAPE 3 ESS04 ESS 04 ESS 04 <u>ESS04</u> ESS04 32 33 NOIN = 0 VAR = 0 <u>ESS04</u> ESS04 ESSD4 ESSD4 FLEVEL = O NOMIN = O NUMAX = O ESSU4 ESSU4 NOVAR = INVAR NVP1 = NOVAR + ESS04 110 00 120 1 = 1, NVP1 130 00 120 J = 1, NVP1 120 VECTUR(1,J) = 0.0 ESSO4 ESS04 140 IF(IFWT) 900, 500, 150 900 WRITE OUTPUT TAPE 3, 905 ESSU4 ESSU4 GO TO 910 150 INPUT = NOVAK + 1 UO 170 N = 1, NODATA ESSO4 ESS04 ESS04 ESS04 160 READ INPUT TAPE INTAPE, 5000, (DEC(1), 1 +1, INPUT) J1 = 1 RUN - DEC(NHUNSE) UATA(NOVAR) - DEC(IDEPSE) <u>ESS04</u> ESS04 00 1613 J= 1, INPUT IF(J - NRUNSE11611,1613,1611 1611 IF(J - IDEPSE11612,1613,1612 1612 UATA(J1) = DEC(J) ESSO4 ESSO4 JL = JL +1 1613 CONTINUE ESSO4 161 WRITE TAPE 8, (DATA(L), L + 1, NOVAR), RUN GO TO (162, 180), INDATA ESSU4 162 HRITE OUTPUT TAPL 3, 9 11, RUN, (DATA(L) , L = L, NOVAK) ESS04 180 DO 190 [- 1, NUVAR | 1) = VECTOR([, NUVAR + 1) + DATA[[] 210 DO 220 J = 1, NUVAR | 220 VECTOR ([, J] + DATA[]) + DATA[]) ESSO4 ESSO4 190 CONTINUE 170 VECTOR(NVP1, NVP1) ESS04 - VECTOR(NYP1, NYP1) A 1-0 230 GO TO 565 CALCULATION SUMS WHEN VARIABLE WEIGHTS ESS04 200 INPUT = MOVAR + 2 DO SIO N = 1, NODATA 20 READ INPUT IAPE INTAPE, 5000 , (DEC(1), [-1, INPUT) J1=1 ESSO4 ESSO JI=1 RVN = DEC(IIRUNSE) OATA(NOVAR) = DEC(IDEPSE) WHY = DEC(INELGI) DO 5204 J=1, INPUT IFI J = NRUNSE! 5201, 5204, 5201 5201 IFI J = NGEPSE! 5202, 5204, 5202 FOR J = HELGY SECON, 5204, 5203 5203 DATA[J] = DEC(J] <u>ESS04</u> ESS04 ESS04 ESS04 ESS04 ESS04 £ \$ \$ 04 85 86 87 88 89 J1 = J1+1 5204 CUNTINUE ESSO4 \$204 CONTINUE \$21 MKITE TAPE 8,(DATA(L), L = 1, NOVAR),RUN GC TU (\$22, \$30), NOATA \$22 MKITE OU[PUT TAPE 3, 9 11, RUN, DATA(L), L = 1, NOVAR) ESSO4 ESSO4 E \$ \$ 04 <u>ES</u>S04 ESS04

REWIND INTAPE WRITE OUTPUT TAPE 3. 5003. (HEADIT). 1 = 1. 12)

550 VECTOR (1, NOVAR + 1) = VECTOR (1, NOVAR + 1) + DATA (1) • BHT
540 DU 540 J = 1, NOVAR
540 VECTOR (1, J) = VECTOR (1, J) + DATA (1) • DATA (1) • BMT
540 VECTOR (NYP1, NYP1) - VECTOR (NYP1, NYP1) - SHM!
COMPLETED SUMS OF SQUARES AND CROSS PRODUCTS. THESE ARE IN
1STORAGE IN LOCATION, VECTOR (1, J). THESE MILL BE PRINTED OUT ON
2TAPE 3 UNDER CONTRUL OF STATEMENT 100

565 NOVAL - HOVAK - 1

ESSU4 ESSU4 ESSU4 ESSU4 ESSU4 ESSU4

E\$504 E\$504

101

SURROUTINE ESSON (CONTINUED)		
MULTIPLE LINEAR REGRESSION CALCULATIONS		
HOLITEE FINENK REGRESSION CARCOLATIONS		
567 WRITE OUTPUT TAPE 3, 90, NOPROS, NODATA, NOVAR, VECTOR(NOVPL, 1NOVPL). EFFIN, EFOUT 570 GO TO 4003	ESS04	105 104 107
570 GO TO 4003 4003 IF(IFRAN) 900,580,650 580 MRITE QUIPUT TAPE 3, 15	ESS04 ESS04 ESS04	109
540 WRITE OUTPUT TAPE 3, 20, (1, VECTOR (1, NOVPL), 1 . 1, NOVNI)	ESS04 ESS04	110
GIO WRITE DUTPUT TAPE 3, 30	ESS04	112
620 MRITE OUTPUT TAPE 3, 35.([[,], VECTOR([,]),]=[,MOVMT],[=],MOVMT] 630 MRITE OUTPUT TAPE 3, 40, ([, VECTOR([,NOVAR],]=],MOVMT] 640 MRITE OUTPUT TAPE 3, 45, VECTOR (MOVAR, NOVAR)	ESS04 ESS04 ESS04	113 114 115
GU TO 650 C CALCULATION OF RESIDUAL SUMS OF SQUARES AND CROSS PRODUCTS	ESS04 ESS04	116
650 IF(IFCNST) 900,651,735 651 IF(VCCIOR(NOVPL,NOVPL)) 652,655	ESSO4	-11%
652 WRITE OUTPUT TAPE 3, 654 GO TO 910	ESSO4	120
655 DO 660 I = 1, NOVAR 670 DO 660 J = 1, NOVAR	ESS04	121
660 VECTOR (1,3) = VECTOR (1,3) - (VECTOR(1,NOVPL) • VECTOR (3,NOVPL)	ESSU4	124
600 VECTOR (1)J) = VECTOR (1,J) - (VECTOR (1,NOVPL) 0 VECTOR (NOVPL,NOVPL) 0 VECTOR (1,NOVPL) 0 VECTOR (NOVPL,NOVPL) 0 VECTOR (1,NOVPL) 0 VECTOR	ESSO4	126
700 IF (IFAVE) 900, 710, 735	ESSO4	127
710 WRITE OUTPUT TAPE 3, 50 720 WRITE UUTPUT TAPE 3, 20, (1, AVE(1), 1 = 1, NOVMI)	E\$\$04	130
720 HRITE DUIPUT TAPE 3, 20, 11, AVE(1), 1 = 1, NOVMI) 730 HRITE DUIPUT TAPE 3, 25, AVE(NOVAR) 735 IF (IFRESO) 900, 740, 760	£5504 £5504	131
740 WRITE OUTPUT TAPE 3, 55 750 WRITE OUTPUT TAPE 3, 35, ((1.), VECTOR(1.)).J-1.MOVNI),1-1.MOVNI)	ESSO4 ESSO4	133
750 HRITE DUTPUT TAPE 3, 35, ([I.J. VECYOR[I.J], J=I, NOVNI], I=I, NOVNI]) 760 HRITE DUTPUT TAPE 3, 40, (II, VECTOR[I, NOVNI), I=I, NOVNI]) 770 HRITE DUTPUT TAPE 3, 45, VECTOR (NOVAR) (NOVAR)	£\$\$04 £\$\$04	135
780 NOSTEP = -1 /81 ASSIGN 1320 TO NUMBER /82 OFFER - VECTOR NUMBER	E\$\$04 E\$\$04	137
790 DU 800 [= 1.NOVAK	ESSO4 ESSO4	139
791 IP(VECTOR(1,1)) 792,794,810 792 WRITE DUTPUT TAPE 3, 793,	E\$\$04 E\$\$04	141
9 1 GO TO 910	ESSO4	144
793 FORMAT (31H ERROR RESIDUAL SQUARE VARIABLE 14,31M IS NEGATIVE, PROB	E\$\$04 E\$\$04	145
794 WRITE OUTPUT TAPE 3,795, I 796 SIGMA(I) = 1.0	ESS04 ESS04	146
797 GD TO BOU 795 FURNATITHOLOH VARIABLE 15,12H IS CONSTANT)	ESSD4 ESSD4	150
810 SIGMA(I) = SURIF (VECTOR (1,1)) 800 VECTOR(I,1) = 1.0	E\$\$04 E\$\$04	151 152
620 UD 830 1 = 1,MUYM1	E\$\$04	154
641 DO 830 J = 1/1, NUYAR ESU VECTUR(1,J) = VECTOR(1,J) / L SIGNA(1) = SIGNA(J))	ESS04 ESS04	154
830 VECTOR(),1) ~ VECTOR(1,1) 860 IF (IFCDEN) 900, 870, 1000 870 MRITE DUIPUT TAPE 3, 60	F\$\$04 E\$\$04	158
SI4 MANS = MANI - I	ESSO4	160
875 DO 885 1 = 1, NOVM2 880 IP1 = 1 + 1	ESSO4 ESSO4	162
85 WRITE OUTPUT TAPE 3, 35,(1,J,VECTOR(1,J), J= IP1,NOVMI) 890 WRITE OUTPUT TAPE 3, 40, (1,VECTOR(1,NOVAR),I=1,NOVMI)	ESS04 ESS04	164
1000 NOSTEP = NOSTEP + 1 1001 IF (VECTUR(NOVAR-NOVAR)) 1002-1002-1010	ESSO4 ESSO4	165
1002 NSTPM1 = NOSTEP - 1 haite output tape 3, 1004, MSTPM1	ESSD4 ESSD4	168
GO TO 1381 1010 SIGN = SIGNAINOVAR) = SORTE (VECTOR(NOVAR, MOVAR)/ DEPRI	ESSD4 ESSD4	170
1015 DEFR =DEFR-1.0 1016 1F (DEFR) 1017,1017, 1020	E\$\$04	171
1017 WRITE DUIPUT TAPE 3, 1019, NOSTEP	ESSO4	173
1020 VMIN = 0.0 1030 VMAX = 0.0	ESSO4 ESSO4	175
1035 NOIN = 0 1040 DO 1050 1 = 1,NOVMI	ESSD4 ESSO4	177
1041 1F (VECTOR (1,11) 1042,1050,1060 1042 WRITE OUTPUT TAPE 3, 1044, I, NOSTEP	ESSO4 ESSO4	179
1045 GO TO 910 1060 IF(VECTOR(1,1) - TOL) 1050,1080,1080	ESSD4 ESSD4	_181 182
1080 YAR - VECTOR(I,NOVAR) - VECTOR(NOVAR,I) / VECTOR(I,I) 1090 IF(VAR)1100,1050,1110	E\$\$04 E\$\$04	184
1100 NOIN = NOIN + 1 1120 INDEX(NOIN) = I	E\$\$04 E\$\$04	186
1130 CUEN(NOIN) - VECTOR(1, NOVAR) + SIGMA(NOVAR) / SIGMA (1) 1140 SIGMCO(NUIN) - (SIGY / SIGMA(1)) + SQRTF(VECTOR(1,1))	E\$504 E\$504	187
KATIO(NOIN) = CUENINOIN) / SIGNCO(NOIN) 1150 IF (VMIN) 1160,1170,904	E\$\$04 E\$\$04	189
904 WALTE CUIPUT TAPE 3, 906	<u> </u>	192
1170 VMIN = VAR 1180 NOMIN = 1	E\$\$04 E\$\$04	193
1190 GO 10 1050 1160 (F(VAR - VMIN)1050,1050,1170	ESSO4	196
1110 IF (VAR - VMAX)1050,1050,1210	E\$\$04 E\$\$04	197
1220 NOMAX = 1 1USU CONTINUE	ESSO4 ESSO4	200
1230 IF (NOIN) 903.1240.1245 903 MRITE DUTPUT TAPE 3, 907	E\$\$04 E\$\$04	201
GO TO 910 1240 WRITE DUTPUT TAPE 3,65, SIGY	E\$\$04 E\$\$04	_2U3
1260 GU TO 1350	E\$\$04_	_205_ 206
1246 CNST = 0.0 1247 GU TU 1300	E3504 E3504	207

1250 CAST - AVELHOVAR)	SUBADUTINE ESSO4 (CONTINUED)		
1890 1890	HULTIPLE LINEAR REGRESSION CALCULATIONS		
1890 1890	ISEA CHEY - AVELHAUMAN	ESSON	200
1300 Fifestip 000,1110,1320 15304 213 1310 Fifestip 1311,1311,1305 187 NOTE 1311, 1311, 1305 187 NOTE 1311, 13	1270 DO 1280 1 = 1,NOIN	ESS 04	
1310 F. HOUGHI 1311, 1311, 1313 1350 1350 1350 1311 MAIT COUPTON 1472 131, MOSTEP N. 1350 1311 MAIT COUPTON 131	1280 CHST = CHST - (COEN(I) + AVE(J))		
1312 CO 10 1315 32 32 32 32 32 32 32 3	1310 IF (NUENI) 1311,1311,1313	ESS04	214
1310 1310	1312 GO TO 1314	ESSO4	216
1310 1310	1313 WRITE OUTPUT TAPE 3, 92, NOSTEP, K	E\$\$04 E\$\$04	
1320 E. VILLE DEFR / VECTOR (INCVAR, HOVAR) 55504 223 231 232	1('INDEX(J).COEN(J).SIGMCU(J).RATID(J).J=1.NOIN)	ESSO4	219
1345 1367 1391 1355 1367 1365	1320 FLEVEL - VMIN + DEFR / VECTOR (NOVAR-NOVAR)		221
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CARD TYPE NUMBER OF ENTRIES			ACCEPTABLE I	DATA SOURCE NUMBER	0	ACCEPTABLE EXPE	RIMENTÄL CONDÍTIONS NUM	BÉŘ
-LMU -ACCEPTABLE FUEL CLASS NUMBERS -MO - ACCEPTABLE FUEL CLASS-GROUP NUMBERS -MO - ACCEPTABLE FUEL CLASS-GROUP NUMBERS -OD - MACCEPTABLE FUEL CLASS-GROUP NUMBERS -PS - CONTRIBUTOR COUNT TEST NUMBERS -QLOVERAIDING COUNT TEST NUMBERS -QC - O - OVERAIDING DECTABL REGRESSION CONTROL DATA -SO - OVERAIDING INTEGER REGRESSION CONTROL DATA -SO - OVERAIDING			ENT	RIES TO BE READ FR	OH THE INPU	DATA CARDS		
-M- 0 - ACCEPTABLE FUEL CLASS NUMBERS -N- 0 - ACCEPTABLE FUEL CLASS AGDUP MUMBERS -O- 0 - UMACCEPTABLE FUEL CLASS-GROUP MUMBERS -P- 3 - CONTRIBUTOR COUNT TEST NUMBERS -P- 1 - COMPITIONAL COUNT TEST NUMBERS -P- 1 - COMPITIONAL COUNT TEST NUMBERS -P- 0 - OVERRIBING DECIMAL REGRESSION CONTROL DATA -S- 0 - OVERRIBING DECIMAL REGRESSION CONTROL DATA -S- 0 - OVERRIBING PART DIME INTEGER REGRESSION CONTROL DATA -S- 0 - OVERRIBING PART DIME INTEGER REGRESSION CONTROL DATA LIST OF COUNT TEST CRITERIA LIST OF CO	CARD TY	PE NUM	ER OF ENTRIES	LIST	SIGNIFICANO	it ,		
-N000000000-						MBERS		
-P- 3 - CONTRIBUTOR COUNT TEST MUMBERS -A- 0 - OVERRIDING DECIMAL REGRESSION CONTROL DATA -S- 0 - OVERRIDING DECIMAL REGRESSION CONTROL DATA LIST OF COUNT TEST CRITERIA LIST OF COUNT TEST CRITERIA LIST OF COUNT TEST CRITERIA ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00000 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00000 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00000 0.00002 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00000 0.00000 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.00000 0.00000 0.00001 1 0 1 1 1 1 0 1 ESSO REGRESSION CONTROL LIST 0.000000			O - ACC	EPTABLE FUEL CLASS	-GROUP NUMBE	RS		
-0- 1 - CONDITIONAL COUNT TEST CRITERIA -8- 0 - OVERRIDING DECIMAL RECRESSION CONTROL DATA -5- 0 - OVERRIDING INTEGER REGRESSION CONTROL DATA LIST OF CONTRIBUTOR COUNT TESTS 1 0 37 4 00 0 LIST OF COUNT TEST CRITERIA 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 0 0 LIST OF COUNT TEST CRITERIA 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 0 0 LIST OF COUNT TEST CRITERIA 1 ESSO REGRESSION CONTROL LIST 0.00100 0.00002 0.00001 1 0 1 1 1 0 0 LIST OF ACCEPTED DATA SERIAL NUMBERS AND FUEL NAMES 2 KIMANE	-0-		0 - UNA	CCEPTABLE FUEL-CLA	SS-GROUP-ME	IBER NUMBERS		
-AS 0 - OVERRIDING DECIMAL REGRESSION CONTROL DATA LIST OF COUNT IEST CRITERIA LIST OF COUNT TEST CRITERIA LIST UF ACCEPTED DATA SENIAL NUMBERS AND FUEL NAMES 2 LUMANE 3 NOCIANE 4 NOCIANE 4 NOCIANE 5 NPENTANE 1 N-INIDECANE 11 N-INIDECANE 12 ISOBUTANE 13 ISO-PENTANE 14 AZMI-PROPANE 15 AZMI-PROPANE 16 AZMI-PROPANE 17 AMEPENTANE 20 AJMH-PENTANE 21 ZEM-PENTANE 22 ZESNEHEKANE 23 CYCLOPROPANE 24 CYCLOPROPANE 25 NECLOPROPANE 26 MECYCPENTANE 27 LAMECYCHEX-NA 28 LAMECYCHEX-NA 28 LAMECYCHEX-NA 29 LAMECYCHEX-NA 30 CIS-BUTENE 30 CIS-BUTENE 30 ALS-BUTENE 30 ALS-BUTENE 31 LOS-BUTENE 32 AMEDITANE 33 CIS-BUTENE 34 CYCLOPROPANE 47 VAICHCHEX-NA 48 CYCLOPROPANE 54 FINAL NEW COLDRESS 55 SECUBENTENE 56 LIMILERIA SENIAL NEW COLDRESS 57 L-DIFFERMAN 58 DETENE 59 1-DIFFERMAN 50 ALBUTENE 50 LIMITERIA 50 ALBUTENE 51 LIF-PENTANE 52 SECUBENTENE 53 PARAXYLENE 54 LIMILERIA SENIAL NEW COLDRESS 55 SECUBENTENE 56 MECHOLORISON 57 LIFTERIANE 57 L-F-PENTANE 58 NC-PH-REIDNE 59 NC-PH-REIDNE 50 NE-PENTANE 50 SHEDNIANE 51 LIFTERIANE 51 LIFTERIANE 51 LIFTERIANE 52 LIMILERIA 53 LIFTERIANE 54 LIMILERIA SENIAL NEW COLDRESS 55 SECUBENTENE 56 MECHOLORISON 57 LIFTERIANE 57 LIFTERIANE 58 NC-PH-REIDNE 59 NC-PH-REIDNE 50 NC-PH-REIDNE 51 LIFTERIANE 51 LIFTERIANE 52 LIFTERIANE 53 LIFTERIANE 54 LIFTERIANE 55 LIFTERIANE 57 LIFTERIANE 57 LIFTERIANE 58 LIFTERIANE 59 LIFTERIANE 50 LI								
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ESSO REGRESSION CONTROL LIST		LIST OF COM	TRIBUTOR COUNT TEST	<u> </u>	•			
### FSSQ REGRESSION CONTROL LIST 0.00100		1 0	37 4 40 0"				•	
1		LIST OF COL	MT TEST CRITERIA					
0.00100 0.00002 0.00001 1 0 1 1 1 1 0 1 IST UF ACCEPTED DATA SERIAL NUMBERS AND FUEL NAMES 2 ETMANG 3 PADPANG 4 NBULANE 5 NPENTANE 6 NOCTANE 1 PADPANG 2 PA		ESSO REGRES	SION CONTROL LIST					
15T UF ACCEPTED DATA SERIAL NUMBERS AND FUEL NAMES 2 ETMANE 3 PROPAME 4 NOULANE 5 NPENTANE 6 N-MEXANE 7 NHEPTAME 8 NOCTANE 3 PROPAME 10 N-UNDECANE 11 N-TRIDECANE 12 ISDUBUTANE 13 ISD-PENTANE 14 AZMEPRADPANE 12 PROPENTANE 12 ZAMEPLATANE 12 ZAMEPLATANE 13 ZO-PENTANE 14 ZAMEPLATANE 15 ZAMEPLATANE 16 ZAMEPLATANE 27 MECVCHEXANE 28 ZAMEPLATANE 28 ZAMEPL		0.40100	0.00002 0	.00001	1 0 1	1 1 1 0 1		
91 1-BRBUTANE 92 1-2CL-ETHANE 93 1-BR-PENTANE 94 28R-BUTEVE-2 95 3-BR-PROPENE 96 CL-22FPRPAME 97 1-2CL2FPRPAN 99 M-F-TOLUENE 111 N-BU-ANINE 112 4-RE-PYRIDINE 113 ETM.NDIANINE 114 2ME-PYRIDINE 116 11MEPRRENZANE 117 ISOPREHLRIGE 119 ISPRPYLBYZNE 120 N-BUTBERENE 121 2-SECRUBENZENE 120 NTHOXYLENE 125 METAXYLENE 126 ANISOLE 127 1-F-PENTANE 128 26-LUTIDINE 129 MPRCHALDRIDE 130 M-MEKANE 133 1-CLPENTANE 134 2BUTANETHIOL 135 1-F-MEXANE 136 ETMYLANRINE 137 D1150PREFENE	20 23 26 ME 33 CI 39 23 46 CV 53 P/ 59 1- 66 NE 72 1- 79 E1	SAMEPENTANE CXCPENTANE S-BUTEVE-1 MEGUTEVE-1 VCLOHEXENE ARAXYLENE -1DJFLETHAN -2CLBUTANE HYLACETATE	21 224MEPLNTAHE 27 MECYCHEXANE 44 TH-BUTENE 2 40 2-MEBUTENE 2 47 4VINCYCHEX-1 54 ELMYLBENZENE 00 1-4FBUTANE 01 2BUCHLORIOR 16 2-CL-PROPENE 80 3MEBORATE	22 225NEHEKANE 28 12MECYCHEX-C 35 N-PENTENE-1 41 4MEPENTEN-2C 48 CYCOCTOENELS 55 SECHUBENZENE 61 111PENTANE 68 1-CIPENTANE 75 ALLYLCHLRIDE 81 ME-Y-AMI-KET	23 CYCLOPRO 29 12MECYCH 36 NPENTEME 42 4MEPENTE 49 PROPYME 56 TEMIBUBE 63 ME-CHLOM 69 ICLZMEPH 76 2CLBUTEN 62 01-ME-EI	PANE 24 CYCLOPE EX-T 31 PAOPY -2 37 ISO-BUT -2 43 2494CPE -3 1 -5 PEN -4 1 -5 P	NTME 25 CYCLOMEXAME NE 32 BUTEME-1 YLENE 30 3ME-BUTEME-1 YLENE 45 2MEBUTDEME13. E 52 TOLUME TAME 50 1-F-MEXAME TOB 65 MPACHLOR 10E KPAME 71 1-9CLBUTAME 78 N-PROPANOL HER 84 P-F-MISCLE	
97 1-2CL2FPRPAN 99 M-F-TOLUENE 111 N-BU-AMINE 112 4NE-PYRIDIME 113 ETHLNDIAMINE 114 ZME-PYRIDIME 116 11MEPRRENAME 117 ISOPRCHLRIDE 119 ISPRPYLBYZNE 120 M-BUTBERZENE 12% IZAMERENERINE 122 SECRUBENZENE 124 ORTHOXYLENE 125 METAXYLENE 126 ANISOLE 127 1-F-PENTANE 128 26-LUTIDIME 129 MPACHLORIDE 130 M-MEXAME 133 1-CUPENTANE 134 ZBUTANETHIOL 135 1-F-MEXAME 136 ETHYLJAMINE 137 DIISOPRSLENE								
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124 ORTHOXYLENE 125 METAXYLENE 126 ANISOLE 127 1-F-PENTANE 128 26-LUTIDINE 129 NPRCHLORIDE 130 M-MEXANE 133 1-CLPENTANE 134 2BUTANETHIOL 135 1-F-MEXANE 136 ETHYLJANINE 137 DIISOPASLENE								
			125 METAXYLENE	126 ANISOLE			DINE 129 NPRCHLORIDE	
136 DIISOPRSLEGX 139 N-BU-SULFIDE 140 ISOBUMRCAPTN. 142 PROPANE	130 N	HEXANE				NE 136 ETHYLBAI	AINE 137 DIISOPRELFME	
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	YTO RESE							
-18			e'-' a matter fait.	te				
DEPENDENT VARIABLE - 3 UMAX/S CMAX XIO LLS OF INDEPENDENT CONTRIBUTORS WITH THEIR CORRESPONDING REGRESSION INDICLES	DEPENL	JÉNI VÄRTÄBI						

•) FOR ESSO ALGRESSIO	
STUPPISE REGRESSION			
YO DE DATA = 118			
NO OF VARIABLES =	· · · · · · -		
NO OF VARIABLES =	DOM - 13	18.00	
F LEVEL TO ENTER VARIABL	.Ė~- 0.00002		** ** ****
I LEVEL TO REMOVE VARIAB	LE = 0.000	11	
STANDARD ERROR UF Y =	170.257925		
STEP NO. 1			
F 1 FVF1 315, 8445			
STANDARD ERROR OF Y =	88.0189		
CONSTANT O. YARLABLE C	OFFERENCE	570 (8808) OF COSE	COLF/STD EXROR
	METFICIENT	SID ERROR OF COEF	
X=L	Q. 23460E_O2	19_3005_Q1	0.177/3t_02
SIEP NO			
VARIABLE ENTERING F LEVEL 110.1560	2		·
F LEYEL 110.1560 STANDARD ERROR OF V = CONSIANT 0.			
VARIABLE C	DEFFICIENT	STO ERROR OF COEF	COEF/STD ERROR
X- 1	0.187382 02	0.10489E 01	. 0.178440 02
SILP NO. 3			
VARIABLE ENTERING	3		
E_LEVEL0.5730	7 .1 .1.72		
STANDARD ERROR UF Y =	63.7267		
VARIABLE C	OEFFICIENT	STO ERROR OF COLF	COEF/STO ERROR
X- 1 X- 2	U.19356E UZ	0.133136 01	U.14540C U2 0.10372# U2
	0.122416 02	0.110020 01	0.103726 02
COMPLETED 3 STEPS OF	-0.84304E U1 REGRESSION	0.11137E 02	-0.756950 00

APPENDIX C

Fortran Programs for Routines FSRTL and FSRDM

804	17	TM	•	t n	TI

MASTER A TRACKY TARE RESEARCHTION SOON CARS A TRACKY

CFSRTL MASTER TAPE PREPARATION FOX FLAME SPEED REGRESSION ROUTINE DIMENSION DIA)LFGCCN12001EGCL(2001BML(2001.DMM(A)	PSRTL PSRTL	1
C INPUT DATA FROM CARD IMAGES ON TAPE 2	FSRTL	
C MASTER TARE LOGICAL UNIT A	ESRTL	
REWIND 6	FSRTL	5
C TITLE CARD	PSRTL	6
READ INPUT TAPE 2, 1000	FSRTL	7
WRITE OUTPUT TAPE 6, 1000	FSRTL	
C NUMBER OF GROUPS ON TAPE	FSRTL	9
READ INPUT TAPE 2. LOG1, 121	F\$rtl	
WRITE OUTPUT TAPE 6,1001, IPI	FSRTL	11
G MAIN DATA GROUPS	FSRTL	
DO 20 I=1, IPI	FSATL	13
READ INPUT TAPE 2:1002; ISPN: EN1. FN2. IFNC. IFNG. IFNM.	FSATL	
1 INDS. INEC. (D(K), K=2,6), IPFGC.(LFGCCN(K), FGCL(K),K=1,	FSRTL	15
	FSRTL	<u></u>
20 WRITE OUTPUT TAPE 6,2002, ISFN, FM1, FM2, IFMC, IFMG, IFMM,	FSRTL	17
1 INDS, INEC. (DIK), K=2,6), IPFGC./LPGCCN/K), FGCL/K1.K=1.	FSRTL	18 19
2 IPFGC)	FSRTL FSRTL	
CCONTRIBUTOR NAMES	FSRTL -	2U
WRITE OUIPHT TAPE 4.2003. (GNL (1). I=1. 200)	FSRT	
C DEPENDENT VARIABLES	FSRTL	23
ATAN MANUT TARE O LARD JOHNATA BALAN	FSRTL	
WRITE OUTPUT TAPE 6. 2003. (DMMII). I=1. 6)	FSRTL	25
END FILE 6	FSRTL	
REWIND 6	FSRTL	- 27
WRITE OUTPUT TAPE 3. 2005	FSATI	<u>2</u>
CALL EXIT	FSRTL	29
1000 FORMAT (1H1.11X. 40H	FSRTL	
1	FSRTL	31
1001 FORMAT(1HO. 16)	FSRTL	3ž
1002 FORMATILE, 244, 516, 2F12.5 / 3F12.5, 16, 16, F12.5 /(16, F12.6,	FSRTL	33
1 16. F12-6. Id. F12-6. Id. F12-4.	F.S.R.T.L	34
1003 FORMAT(12A6)	FSRTL	35
2002 FORMATILHO, 16, 246, 516, 195612-4, 14/ 11H , 16, 812-4, 16, 812-4		
1 . 16. E12.4, 16. E12.4, 16. E12.4, 16. E12.4))	FSRTL	37
2003 FORMAT(1MO, 9(6X,A6)/(1M 6XA6, 6XA6, 6XA6, 6XA6, 6XA6, 6XA6,	FSRTL	38
1	FSRTL	39
2005 FORMATITHE 25X-28HTAPE & PREPARATION COMPLETE	FSRTL	40
END	FSATL	41

ROUTINE FERDIN

MASTER CARR I TARARY MORIEICATION

CFSRDM C	MASTER DECK MODIFICATION FOR FLAME SPEED REGRESSION ROUTINE PREPARE TAPE 14 FOR PUNCHING OF CHANGES IN MASTER TAPE	FSRDH FSRDH	
Ç	NOMENCLATURE	FS2DA	
É	MRGPOT - MUMBER OF DATA GROUPS PREVIOUSLY ON TAPE NDGCOT - NUMBER OF DATA GROUPS CURRENTLY ON TAPE	<u>FSRDM</u> FSRDM	
	NDGCOT - NUMBER OF DATA GROUPS CURRENTLY ON TAPE NDGCHGNUMBER OF DATA GROUPS ALTERED	FSROM	
Č	TOCCUPING - CODE WINDER OF ALTERED DATA COMING	FEROM	
Č	NADO	FSRDH	
C C	ICONAM - CONTRIBUTOR NAME PUNCK SWITCH 1-PUNCH 2-UMIT '	FSRDH	
	TONAL DEFENDENT ANTINDE LANGE TO THE TANKE THE		<u> </u>
	THENSION IDECHE(10000) , LEGGEN(90), EGEL(90), GNL(200), DMM(6)	FSRDM FSRDM	i
	, D(6)	FSRDH	i
		FSRDH	i
	EAD INPUT TAPE 2, 3000, NOGPOT, NDGCHG, ICOMAM, IDPNAM	#SRD#:	1
	F(_NDGCHG)_10, 20, 10	ESRON	
10	EAD INPUT TAPE 2, 3001, (IDGCHG(K), K=1, NOGCHS)	FSRDH	1
	READ TITLE AND NUMBER OF GROUPS FROM MASTER TAPE AND PUNCH.	FSRDM FSRDM	l
ZO	EAD INPUT TAPE 6, 1000 EAD INPUT TAPE 6, 1001, NOGCOT	FSROM	2
:	RITE DUTPUT TAPE 14, 1000	FSRDM	2
	RITE DUTPUT TAPE 3. 1000	FSRDM	ā
	• 1	FSRDM	2
1	RITE OUTPUT TAPE 14. 1001. NDGCOT	FSRDM	2
	RITE OUTPUT TAPE 3, 1001, NDGCOT	FSRDM	3
	PI NDGCOT - NDGPOT) 100, 30, 30	FSRDM FSRDM	
3U I	O 45 1=1, NDGCOT EAD INPUT TAPE 6 .2002.ISEN.ENL. EM2. IENC. IENG. IENM.	FSRDM	. 2
	INDS. THEC. (DIK), K-2.61, IPFGC, (LFGCCN(K), FGCL(K),K-1,	FSRDM	- 2
ž	IPFGC)	FSRDH	š
			3
32	F(I - IDGCHG(L).) 40. 33. 40	FSRDM	3
33 1	* L + 1 RITE OUTPUT TAPELS 1002:ISEN:EN1, EN2, IENC, IENG, IENG,	FSROM	3
بەد_	INDS: INEC: { D(K): K=2:6}: IPFGC: (LFGCCM(K): FGCL(K):K=1:	FSRDM	
Ļ			3
~40°1	RITE OUTPUT TAPE 3,2002,15fN,FN1, FN2, IFNC, IFNG, IFNM,	FSRDM	3
_ ``l	INDS, INEC, (D(K), K-2.6), IREGG.(LEGGGNIK), FGGLIKI.K-1.		š
2	IPFGC)	FSROM	3
65	ONTINUE	ESRON	<u>_</u>
	EAD INPUT TAPE 6 , 2003, (GML(I), I=1, 200) EAD INPUT TAPE 6 . , 2003, (DMM(I), I=1, 6.)	73RUM	•
'	D TO ISO, 601.ICOMAN	FŚRON	7
50	RITE OUTPUT TAPE 14, 1003, IGHLII1, 1+1, 2001		š
	RITE OUTPUT TAPE 3, 1003, (GNL(I), 1-1, 200)	FSRDM	4
40 (O TO (70. BO). IDPNAM	F&RDH	٠.
70 1	RITE OUTPUT TAPE 14, 1003, (DMMIT), 1=1, 6) RITE OUTPUT TAPE 3, 1003, (DMMILL, 1=1, 6.)	FSRDM	4
-0.1	RITE DUTPUT TAPE 3, 1003, IDMMILL, 1=1, 6.J.	FSRUM	- 1
	ALL EXIT	FSRDH	5
100	RITE OUTPUT TAPE 3, 4001	FSRDM	5
	O TO 90	ESRDM	5
	ORNAT(1H1,11X, 60H	FSRDH	5
1	3	7SRDM	5
1001	ORMAT(1H0, 1A)	FSRON FSRON	ş
	ORMAT(16, 246, 516, 2E12.5 / 3E12.5, 16, 16, E12.5 /(16, E12.5,	FSRDH	5
	16, E12.5, 16, E12.5, 16, E12.5)) ORMAT(12A6)	FSRON	- 5
2002	ORMATILHO. 16. 246. 516. 1P5E12-4. 16/ (1H . 16, E12-4. 14, E12-4	FSRDM	5
2003	DRMAT(1HQ. 9(AX.A6)//1H . AXAA, AXAA, AXAA, AXAA, AXAA, AXAA	ESRDH	
1	SXAS, SXAS, SXAS }]	FSROM	6
3000	DRMATI AIGL.	F\$RDH F\$RDH	- •
3001	ORMAT(1216)	FSRDM	
1000	ORNATILHI. 25x. 35HMASTER DECK MODIFICATION COMPLETE. 1 DRNATILHI, 25x,46HERROR - MORE DATA GROUPS IN LIBRARY THAN OM TAP	FSRDM	
4001		FSADN	
	IND	FSRDM	

1. Computer & Data Systems 2. Flame Speed Data 3. Correstation Technique 1. WESC Project 6075. II. Contract NV33(657). III. Monanto Research Corp., Dayton Onlo Onlo. IV. G. H. Ringrose, et al. V. G. H. Ringrose, et al. V. G. H. ANTIK collection VI., in ANTIK collection	1. Computer & Data Systems 2. Fines Speed Data 3. Correlation Technique I. AEC Project 6075, II. Contract AF33(57)- III. Monerot AF33(57)- III. Monerot AF34(57)- III. Monerot AF34(57)
Aeronautical Systems Division, Dr/Aeromechanics Filght Accessories Lab, Wright-Tatterson AEE, Ohio Rev No. ASD-TRR-65-182. FLANZ SPEED DAMA ALMOTION Reports, Feb 63, 89 p. And Milles, tables, 6 refs. Unclassified Report Two digital computer routines were developed to process flams speed data resulting from the burning of compounds in air oxygen, and to correlate par- ticular structural configuration with flams speed. In both routines a high degree of flexibility has been incorporated to assure efficient utilization under several forseeable circumstances. The first routine, FSC, processes the raw experi- mental data to obtain flams speeds equivalence revices, and the equivalence ratio at the maximum flams speed. This information is stored on a master magnetic tape for subsequent calculations. The second routine, FSR, paraits se- lection of specific data groups from the master tape for subsequent calculations the master tape for subsigning.	Aeronautical Systems Division, Dir/Aeromechanics Plisht Accessories lab, Wright-Petterson AFB, Onio Rpt No. ASD-TRE-63-182. FLAME SPEED DAYA REDUCTION RAD CORRELATION USING A DIOITAL COUPUTS. Final report, Feb 63,89 p. incl illus., tables, 6 refs. Unclassified Report Two digital computer routines were developed to process films speed dats resulting from the burning of compounds in air oxygen, and to correlate particular structural configuration with flame speed. In both routines a high degree of flexibility has been incompared to assure efficient utilization under several forseanche circumstances. The first routine, FSC, processes the raw experimental data to other flame speed, adjulance results after adaptic tape for subsequent calculations. The second routine, FSC, permits selection of specific date groups from the master tape for analysis. A linear model was chosen for the correlation.
1. Computer & Data 2. Fines Speed Data 3. Correlation Technique 1. AFGS Froject 6075, II. AFGS Froject 6075, III. Monanto Research Corp., Dayton, Ohio V. O. H. Ringrose, et al. V. In ASTIA collection	1. Computer & Data 2. Flame Speed Data 3. Correlation Technique 1. AFOS Project 6075, 11. Contract AF33(657)- 11. Monanto Reserch Corp., 1V. A. Hingrose, et al. V. A. H. F. O77 VI. In AFTIA collection
Aeronautical Systems Division, Dir/Aeromechanica Systems Division, Dir/Aeromechanica Systems Division, Dir/Aeromechanica Systems and Systems and Systems and Systems and Systems are Systems and Systems and Systems are Systems and Systems and Constituent and Constituent and Systems and Systems and Systems and Systems and Systems are speed. In both routines, a high degree of flexibility has been incorporated to assure efficient utilization when large several forescent of saure efficient utilization and a first routine, FSC, processes the raw experimental and the equivalence ratio at the maximum flace several forescent as stored on a master sagetic tape for subsequent calculations. Incline assent runs information is stored on a master sagetic date groups from the maximum the sascent routine, FSR, permits series are for subsequent calculations. Inclined specific date groups from the maximum the sascent routine, FSR, permits series are asset tape for subsequent calculations.	Aeronautical Systems Division, Dir/Aeromechanics Flight Accessories lab, bright-settemen AFB, Onio Prigit, ACCESSORIES lab, bright-settemen AFB, Onio Processories lab, bright-settemen AFB, Onio Processories lab, bright-settemen AFB, Onio Processories and a processories of the settement of the settement of setteme